Gary A. Moore
Operations Staff
Chlor-Akali Division

Formosa Plastics®

Formosa Plastics Corporation, Texas
201 Formosa Drive • P.O. Box 700
Point Comfort, TX 77978
Phone: 361-987-8537
Fax: 361-987-7484
Email: garym@ftpc.fpcusa.com
Web: www.fpcusa.com

TETRA TECH

Douglas E. Laymon, PG
Senior Geophysicist / Hydrogeologist

8911 North Capital of Texas Highway, Building 2, Suite 2310, Austin, TX 78759
Tel 512.338.2860 Cell 512.940.3613 Fax 512.338.1331
doug.laymon@tetratech.com www.tetratech.com

Formosa Plastics Corporation TX
201 Formosa Drive
Point Comfort TX
~~TXD~~
TXT 490011273

TXT 490011273

8/20/2012 Formosa

(R)

~~1~~0 1605 Arrive Formosa to obtain security pass. Meet Matt Brogger, environmental manager.

1625 Depart Formosa with credentials

1642 Arrive hotel to check in and establish computer sign in.

1720 End of day

Intentionally Blank

8/21/2012 START

6:42 am

Weather: Overcast with expected sunshine mid 90s anticipated. Low 80s in the morning

7:40 Dept hotel

7:57 arrive Formosa

8:00 Meet Matt Brogger + gain entry

8:05 ar Erik Klink, Ross, Tetra Tech

812 ar Maureen, TCEQ

830 Begin ppt
SWMUs/AOCs
Receive handout
Begin w/ explanation of areas
Discussion about post closure permit
Maureen will list all SWMUs/AOCs in permit + close or keep as it is on record.
Begin w/ SWMUs.
All notes on handout

o Requested integrity testing report for NOR #39 SWMU 7

o Requested most recent analytical results for NOR #43 SWMU 9 Blowdown pad

~ 60 other SAA areas across facility
All employees handle waste the same manner.

8/21/2012 (Cont)

o Requested copy of analytical results for AOC-2 Soil pile.

o Requested SPCC for Central Maintenance Used Oil Storage Vessel

1050 Begin site tour at North End
Soil pile 1st AOC2
Began ~ 2009
~ 4ac
Has concrete, soil debris
1100 * Photo 1 Facing N Concrete washout pond area at Soil pile (concrete removed once hardened and stored at soil pile area)
Photo by M. Brogger
Have some soil disposal from newest construction and road base for reuse
Concrete - attempting to reuse/crush
Soil reuse? Still trying to identify use.
Have 2nd soil stockpile for FRAC 2 expansion project.
1112 SPVC Container Storage SWMU 11 90d
* Photo 2 Facing W SWMU 13 SAA
1117 SWMU 11 90d storage
7 drums, 1 spill kit.
* no picture of SWMU 13
Asked about disposal of tedlar bags in SAA.
Are they evacuated + disposed or what?
1125 AOC 6 Wash pad + Used Oil tank

8/21/2012 (cont)

* Photo 3 Used oil tank

1130 * Facing W

O/W separator located immediately E of used oil tank.

O/W - out of service because too slow

1136 * Photo 4 Facing SW

O/W separator & pits. Have weirs separating 3 areas. Bridge unit.

Water vac'd out & sent to WWTP.

Check for cracks during inspection -

* FPC will check for frequency

Some oil (minor) drainage in ~~NE~~ SE side of curb

1145 SWMU 9 Raw water Pond/demin

* no picture (could not see demin side only raw water intake.

1201 Rtn to EHS facility

1205 Break for lunch

1240 Paperwork

1253 Depart back to facility

Tech Labs - SAA & 90d CSA

2 storage areas - 1 for R&D, 1 for gen chem.

~~1308~~ * Photo 5 SW CSA <90d

1308 SWMU 13 no pic SAA Have 1 container for liquids (~ 4 gal) and 1 container for solids (~10 gal). Have empty glass containers stored in area. All under ventilated hoods to control volatiles.

8/21/12 Continued

2 SAAs - 2 in R&D areas

at 2nd area, employees were cleaning out reactor units and storing wastes under hoods for SAAs

1321 Dept Tech Labs to LLDPE

AOCs 3 & 4

Water separation Tank Oil 5 for hexane/water hexane goes to other end & then is shipped off site to customer

* 1333, no photos to Tank 530 ~~waste~~ heavy ends Tank 530 Gutter stock - used for storage only - no treatment

1340 * no photo

1346 Leave LLDPE for ~~Chloralkali~~ PE/PP

AOC 5 Waste hexane drum

waste hexane stripper

1358 - Waste hexane drum in "sump" area ~6' bgs. has "sump" area for rainwater that flows to WWTP.

Waste stripper located immediately S of "drum" and is used to separate water & hexane. Hexane is recycled back to process. Clean areas

* no photos taken

1408 Depart ~~Chloralkali~~ PP/PE arrive Chloralkali

1410 SWMUs 1→6

water Break

8/21/12 continued

1420 Inspect SWMU 1-6
1428 Tanks 405, 407A, 407B
405 not used, closed by TCEQ
407A ~~HW~~ Heavy ends product → PPG
407B ~~HW~~ " " " "
1430 * Photo 6 of all 3 tanks
Facing SW
1435 SWMU 6 CSA in EDC
scrap metal
* Photo 7 Facing W CSA storage
SWMU 5 Treatment unit for
stripping for EDC
tank rupture release in
1992. ~~The~~ Treatment
pad not present. Has overhead
lines + gravel base.
* no photos SWMU 5
SWMU 10 - CSA in EDC - waste acid to CSA
Hg-contam. Not using CSA. Removing
from NOR.
* 1448 Photo 8 CSA in EDC plant. 14/16
Heat from 1 box/16 hrs to 1 box/~~8~~ days
Boxes - drain mud out pad to drain it dry
+ then move to Pod Storage
Water pumped back into brine system. Recovery
Mud goes to Attain Lf asel 3%)
Poly lined boxes * no photos
1507 Rtn to Chlor alkali bldg - water break

8/21/12

7, 12,

1520 Depart chloralkali plant ~~to~~ to outfalls 6, 7, 8, 9
Outfall 006 - drains most of Southern cal facility
1528 * Photo ~~8~~ 9(F) no pellets. Area is cleaned.
no trash area. Facing N for Stormwater
Outfall 007 drains around CWTP +
inland traffic
1536 * Photo ~~9~~ 10(F) Outfall 007 Facing E
no pellets, no trash. Minnows in
Sumpanea
1537 Outfall 008, no pellets, no
trash. Minnows, some mud.
* No photo. Drains PP2, utilities, EG plant, some Olefins
Storage yard NE - drain fluids before
storage - ultimate scrap metal.
Creosote ties - reuse for road area mats
1543 Outfall 009 no pellets no trash
Some dirt. Drains PE2, Olefins, Frac2 and N to
maintenance shop, side roads, Northern end
of facility
1602 Rtn to H+S Bldg for afternoon
wrap-up
1620 Download files to diskette for Matt B.
1635 Depart Formosa
1653 Rtn motel
1658 Download information onto logsheets
1725 end of day

Formosa
Inspection

8/22/2012 start

0829 Arrive Formosa
0840 Prepare for field (fr)
0853 Head into Plant to ~~CWTP~~ Olefins
0902 Zimpro spent caustic & Pi gas
separate caustic from Pi gas
Caustic mixed w/ acid &
then sent to stripper to water
to CWTP and organics to flare;
neutralize caustic.
Zimpro - WWTP. - consists of
storage, neutralization unit,
stripper not part of Zimpro
no photo
0919 Dept Olefins 1
0922 Arrive Olefins 2
Built 1998-2002 along w/
PE2, PP2. ~~Same~~ (construction
design as Olefins 1)
(AGR/LEHO Carbon tanks -
scrub for Benzene &
then water from to tanks for
Treatment for caustic &
Strip for organics.
no photos
0942 Dept Olefins 2
0945 Arrive CWTP
* 0957 Photo 1 Brine chiller. Both
pumps operational. Continued

8/22/12 Continued

Process changed so not as much
brine to Joule pumps.
TE104 Brine chiller.
TT094 - Back in operation since
cleaning in 2010.
Empty drum storage - triple rinse, log,
contact EHS, disposal.
Organic lines - Plants A+B
Headworks - 2 process, 2 stormwater headers
01A } EQ tanks for organics
02 }
01B Cu heavy streams
also have hot water coming in that must
be cooled to at least 95-105°F for
microbes
Rear header (E) - have some pellets on
ground near chiller units; collected
into storm water system & then back
into bio treatment system.
2010 had overflow due to 2 clarifiers
down + Tropical Storm Hermine. Contacted
TCEQ, sampled, no exceedance.
Between tanks 01A + 02 - have decant
water to storm water drainage
back to system. Decant water from
solids compression area tank.
belt
before sending to press. ~60% solids
for shipment.

8/22/12 Cont.

Tank 01B - goes to Cu unit. Have Cu removal area all solids from this area (incl Cu) are sent to tank + water decanted. Then solids go to filter press. Cu comp unit can get Cu < 50 ppb.

1015 # Photo 2 Cu comp unit. Facing N. no drainage on ground.

1017 Roll-off box sludge storage. Class II non haz. Goes to landfill.

1020 # Photo 3 Roll off box storage for solids from belt press.

3 Aeration tanks mixed liquor TT-08C recycle stream from PVC water, treated + pumped to Cogen for cooling tower makeup water.

A+B - organic ww + storm waters

3 clarifiers TT-09 A, B, C.

Bioreactors → to 3° treat / more clarification. Can pass thru other treat for organic but only use. Tpt out Cu in 3°. Cu limit 25 ppb daily average.

8/22/12 (Cont)

CB lock - Physical treat - pH adjustment + solids

Inorganic train - Chlor Alkali + demin units (neutralize + sludge)

- cooling tower treat train Hi TDS Ca

Treated sanitary - thru pkg unit + released to tank for recycle for cooling tower makeup water.

Solids handling - comp removal, blowdown on clarifiers, blowdown on physical. Decant before pressing.

TT-22, TT 30, TT 24, TT 29

Decant + press water stored in TT 33 + sent back to front.

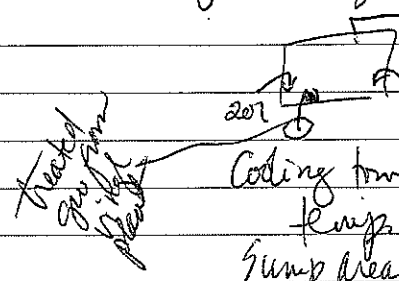
1030 Two roll off boxes in press area. Want to have as dry as possible. Solids generation a function of flow volumes. Add polymer to remove water + solidify solids. Chemical storage bldg located NE belt press

1040 Outfall ~~001~~ 101 and 201

201 biological

101 physical

go to outfall 001 to Bay



Cooling towers to meet discharge permit temp.

Sump area solids considered haz due to [illegible] treat. Store solids in drum for

8/22/12 (Cont)

1045 Photo 4 Facing S HW storage area + drum at WWTP for VCM gw treat solids.

1048 Depart CWTP

1052 Arrive HDPE II

1105 Arrive at HDPE sump - tank receives drainage from catalyst bldgs - Chrom/chromate mixed. Receives runoff from area

Clean ~ 2-3 yrs - vac out offsite disposal - results

No photo Normally water flows to CWTP except when Cr high or ~~solids~~ ~~bad day~~ for ~ 10-12ft deep.

Roll offs contain spent plastic - SWMU product

T801 pellet cutter wastewater tank -

1110 Holds water from underwater cutter used to wash out fines. Pellets & fines floated & contained in bags & stored in roll-offs.

No photo Water to CWTP. Have filters for fines. Have pump before tank to settle/float some solids before 1st filters. Physical separation

1119 Depart HDPE II

8/22/12 (continued)

1125 Return EHS office. ~~Water break~~

Late entry - weather clear to partly cloudy. Start in mid 70s projected to low 90s. Humid.

Photos taken by Matt Bragger w/ GPA Camera S28099 Canon PowerShot A570 internal date & time not working properly

1202 Begin asking questions identified when filling out SWMU/AOC forms

Received copy of power point from Tetratech (electronic - pdf)

1220 Begin discussion about TCEQ permitting requests and concerns/ issues to submit application.

1400 N Fogg arrived. Credentials

Begin discussion for Scoping Mtg to work on CAS issues

Karen Scott - permit writer

Notes included on handout from Tetra Tech

Next: schedule for Scoping Meeting Notes

: Establish electronic bulletin board & meeting notes for "email Team"

: Next schedules for discussion with TCEQ, EPA, Formosa, Tetratech

: Communications

1655 Depart Formosa end of day at facility

Formosa mtg

8/23/12 START

8:30 Arrive at Formosa

Weather: low 80s to start, sunny. Expected to get to mid 90s. Humid.

Matt Wickham PBW

Go over action items - handout (Verbal)

EDC Area geology

Zones A, B, C - similar sands across site.

In EDC, Zone A sand much thinner than the southern area. ~1 ft thick.

at Alcoa, Zone A ~~sand~~ 3-5' thick

Bottom of zone A at ~ 0' MSL

Considered units to be consistent based on 20+ yrs in area. Water + potentiometric data.

Hi resol resistivity data from Former Brookings. Hi salt causes interference.

Have some geoprobe borings. Only worked in A sand. No anomalies noted.

(fine sand, little clay, some silt)

Zone A was present in Brookings. No thick Zone ~~B~~ sand on other side of 35 (~~Brookings~~ EPC side) (x)

New wells have 8-10' sand thickness. Top of sand ~10' bgs

Discontinuous sand channel but continuous A Zone. Hydraulic head pushing from Alcoa redbeds in mounding effect. Concern is that EDC flowing around Red Bed area of influence

8/23 continued

Alcoa - some sands above X sand called Y sand.

P wells - perched

D wells - deep

Groundwater recovery -

Feel plume delineated. No NAPL identified

Main plume is SE Bathane

contam hotspots probably from sump leakage. Flowing SE in Zone A

>1000 mg/L is around hi. Pumping consistently from recovery well. Only 1 Zone B well immediately downgradient of spill area. Zone A is 1-2' thick with silty clay + sand stringers

No C wells.

0930 AOC determination

Prepare letter for Buried drum survey under 3008h)

1100 Randy Smith joined for concluding comments

Summarize NFA, Keep, maybe list for SWMUs/AOCs.

Action items - GW Rpt from EPA to Formosa

- Letter for Formosa for 3008h Area for drum burial area

- Railcar maintenance area laydown

8/23/12 continued

- Permit application process communication
- Work group conference calls, email groups
- Scoping Meeting Report due in 45d - Oct. 8
- Formosa to compile and send outstanding information next week.

1205 Meeting adjourned

Depart Formosa facility for Houston Hobby Airport & return home

FW: Formosa
Matt Brogger/FTEHSF to: Nancy Fagan, Frances Verhalen 08/16/2012 04:05 PM

From: "Matt Brogger/FTEHSF" <MattB@ftpc.fpcusa.com>
To: Nancy Fagan/R6/USEPA/US@EPA, Frances Verhalen/R6/USEPA/US@EPA

Nancy

See below for answers to questions from the conference call concerning the Treatability Study Work Plan.

Matt

From: Matt Wickham [mailto:matt.wickham@pbwllc.com]
Sent: Thursday, August 16, 2012 2:27 PM
To: Matt Brogger/FTEHSF
Subject: FW: Formosa

As discussed

From: Stan Haskins [mailto:shaskins@insituoxidation.com]
Sent: Wednesday, August 15, 2012 8:36 AM
To: Matt Wickham
Cc: pkakarla@insituoxidation.com
Subject: RE: Formosa

Matt,

Prasad and I discussed this yesterday. Prasad is our lab expert and in charge of all bench studies.

1) We have never had consistent results with chlorine production. There is a lot going on ISCO reactions geochemically. I have seen chlorine used as a better indicator of chlorinated destruction on bio projects. So we do not recommend it, although it can be done for a few hundred dollars in analytical cost.

2) Prasad is purchasing a water bath for the heated experiments. Both the control and sample will be heated to approximately 40 degrees C. Any direct volatilization will be accounted for in the control.

3) Prasad will have the lab do a VOC analysis with a forward library search of up to 10 tentatively identified compounds (TICs) i.e. VO+10 analysis.

Stan
ISOTEC

Office 303-843-9079
Cell - 303-931-4257

From: Matt Wickham [mailto:matt.wickham@pbwllc.com]
Sent: Tuesday, August 14, 2012 9:45 AM
To: Stan Haskins
Subject: Formosa

Stan – I just got off of a conference call with EPA regarding our work plan that includes the ISCO bench scale tests. They had two questions for you:

1) Is there any reason to also analyze for chlorine in the soil and groundwater samples?
2) How is the sample heated in the heat-activation portion of the sodium persulfate test?

Also, the EPA is interested in the degradation of other VOCs in the soil/groundwater also. We had not specifically discussed this but I assume we will be able to also see degradation of other compounds since we are analyzing the samples for the VOC suite 8260. Examples include chloroform, vinyl chloride, 1,1-DCA, 1,1-DCE, trans- and cis-1,2-DCE, TCE, PCE, chlorobenzene, 1,1,2-trichloroethane, and benzene.

Thanks
Matt

Matthew K. Wickham, P.G.
Pastor, Behling & Wheeler, LLC
620 E. Airline
Victoria, TX 77901
(361) 573-6442
(361) 573-6449 fax
(361) 652-1756 cell
www.pbwllc.com

Is there a problem w/ X contamination? ~~without~~ with Temp well?

9/6/12 Formosa call

Drilling for AOC Charact WP.

SMW-B1 – did not hit B sand to 70' bgs

BZone piezometers on Formosa property in B sand – Want to review data to look at where to put B-zone well for sentinel

Zone A – 16'-20' screen depth SMWA3 10-18.9' sand

Zone B – sand stringer at 30.5-31.1, moist but not wet. then clay to 70'. ~~Permit only~~

Bzone sand thins & goes away.

TPZ-AOC-B1 (West) 39.8-42.1' sand, wet, 5' screen, temporary

– B2 (east) 36.6-43.8' sand 39-44 screen w/ filter sand, temporary

Defer decision until data collected & analyzed.

Still need to see about Zone C.

Zone A	screen interval	5'
B	"	5-10'
C		10'

Drilled Zone C well – thick (~6' silty clay btwn Zones B & C) ~ 30' thick Zone C sand w/ 10' screen at bottom. Temporary

Completed A wells: A-1, A-2 on either side of creek on Brookings Property. (~ 200' either side)

PID readings – bkg

sampled { No odor, discoloration in samples,
Sp cond: 2,000-6,000

o Send Nancy ~~Farrell~~ Former Brookings Property Rpt

ISCO Treatment Program:

Chlorinated VOC Impacted GW

Site

- Active Military Base; Virginia.

Contaminants of Concern

- Tetrachloroethylene (PCE)
- Trichloroethylene (TCE)
- Vinyl Chloride (VC)
- Cis-1,2-dichloroethylene (cis-DCE)

Geology/ Hydrology

- Fine to medium silty and clayey sand matrix underlain by a sandy clay semi-confining unit at 35 feet bgs.
- Average hydraulic conductivity was 1.02×10^{-2} cm/sec in the shallow water bearing unit.
- Depth to water approximately 15-20 feet bgs; with flow in the easterly direction.

ISCO Pilot Program

- Sodium Permanganate.
- 4,500 sq ft area.
- One, 8-day injection event.
- Direct-push technology targeting multiple depth intervals of 15-25 and 25-35 ft bgs.

Results

- Treatment program results indicated a sharp reduction in the concentration of VOCs, with overall site-wide contamination reduced by >86% on average and > 92% in the treatment area.

IN-SITU OXIDATIVE TECHNOLOGIES, INC.
WWW.INSITUOXIDATION.COM

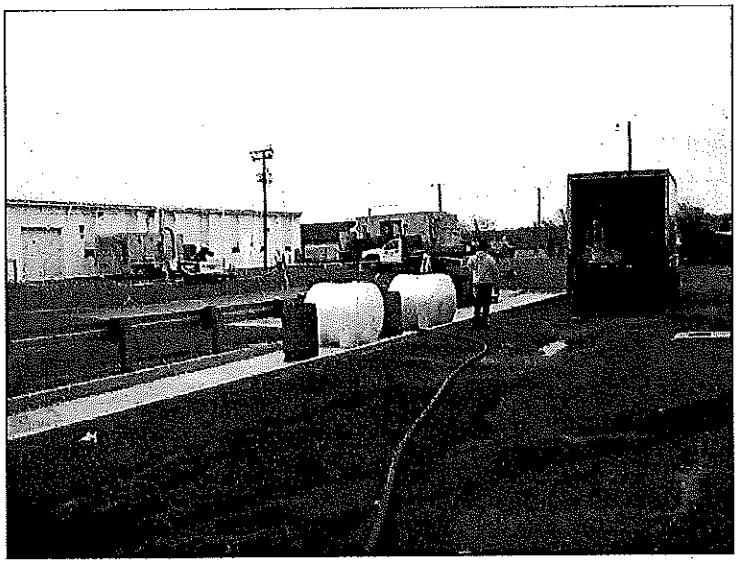
ISOTEC Case Study No. 36

ISCO TREATMENT PROGRAM: CHLORINATED VOC IMPACTED GROUNDWATER

Active Military Base – Maintenance Building Site
Virginia

INTRODUCTION/ SITE BACKGROUND

Contaminants of concern at the Maintenance Building (MB) Area site within an active military base are chlorinated volatile organic compounds (VOCs), primarily tetrachloroethylene (PCE), trichloroethylene (TCE), vinyl chloride (VC), and cis-1,2-dichloroethylene (cis-DCE). The average TCE levels detected in groundwater prior to in-situ chemical oxidation (ISCO) remediation were 326 micrograms per liter (ug/l).



The target treatment area consisted of 50 ft x 100 ft area [approximately 4,500 square feet (ft^2)]. The target vertical treatment zone covered the 20 to 35 ft bgs depth interval. An oxidant demand test using sodium permanganate was completed prior to the ISCO treatment program to determine the optimum dosing. Results were used to design a field-scale application of sodium permanganate at the subject site.

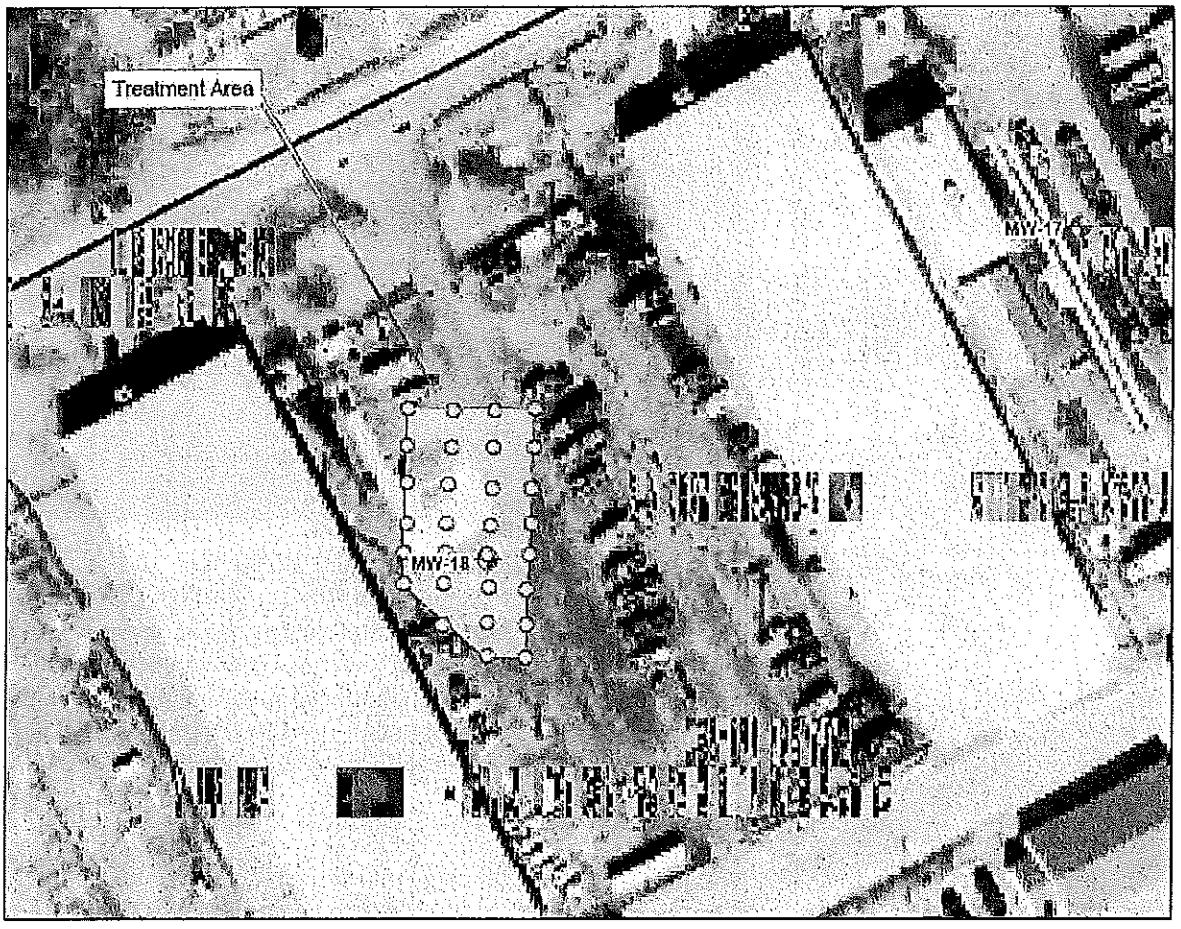
GEOLOGY

General subsurface lithology at the site consists of fine to medium silty and clayey sand matrix underlain by a sandy clay semi confining unit at 35 feet (ft) below ground surface (bgs). The average hydraulic conductivity was 1.02×10^{-2} centimeters

per second (cm/sec) in the shallow water bearing unit and ranged from 7.5 x 10^{-4} cm/sec to 9.68 x 10^{-4} cm/sec. Groundwater was encountered at 15 to 20 ft bgs and generally flowed in the eastern direction. Average subsurface porosity was determined to be 0.25.

ISCO TREATMENT PROGRAM AND IMPLEMEMENTATION

Treatment program injection locations were installed utilizing a direct push drill rig fitted with 1.5-inch steel rods and an 8 ft stainless steel slotted screen within the injection interval. Twenty-four (24) dual-interval injection locations (i.e. 48 intervals) were utilized at the site for injection purposes. The shallow intervals targeted the 15-25 ft bgs zone and the deep intervals targeted the 25-35 ft bgs zone. Once reagent injection was completed in the shallow interval, the injection point was vented, the direct push rods were completely retracted from the hole, and the borehole was filled with sand and bentonite, and topped with asphalt patch. Injection pressures noted at the site were typically in the range of 10-30 pounds per square inch (psi) with several locations recording pressures as high as 50 psi during injections. A total of 4,800 gallons of 10% sodium permanganate was injected at the site at an average flow rate of 4 gallons per minute (gpm).



RESULTS

Treatment Program results indicated a sharp reduction in the concentration of VOCs, with overall site-wide contamination reduced by over 86% on average and over 92% in the treatment area.

Sample ID	MW-18		MW-10		MW-17		MW-22	
Sample Date	April	June	April	June	April	June	April	June
VOC								
1,1-DCE	0.29 U	5 U	6.34	5 U	6.15	5 U	0.29 U	5 U
Cis,1-2-DCE	68.4	5 U	15.9	6.9	17.1	3.2	7.31	7.6
TCE	**326**	5 U	**19.9**	5 U	**26**	5 U	**31.2**	**21**
PCE	1.02	5 U	20.8	5.8	22.2	2.0	1.38	2.7
Acetone	5 U	30	5 U	25 U	5 U	25 U	25 U	25 U
Total VOCs	395.4	30.0	62.9	12.7	71.5	5.2	39.9	31.3
% Reduction	-	92%	-	79%	-	92%	-	21%

Note:

U = Analyte was not detected, Bold = above MCL

CURRENT PROJECT STATUS

A Remedy-In-Place designation was achieved for the site and no further injections are proposed.

ISOTEC

ISCO Treatment Program: VOC Impacted Bedrock

Site

- Truck Maintenance Facility; Central New Jersey.

Contaminants of Concern

- Tetrachloroethylene (PCE)
- Trichloroethylene (TCE)
- Vinyl Chloride (VC)
- 1,1-dichloroethylene (1,1-DCE)
- Carbon Tetrachloride (CT)

Geology/ Hydrology

- Unconsolidated materials underlain by a shale competent bedrock.
- Depth to groundwater is approximately 6 feet bgs.

ISCO Treatment Program

- Modified Fenton's Reagent (MFR) & catalyzed sodium persulfate (CSP)
- Two, 5-6 week injection events.
- Sixty bedrock injection wells targeting multiple depth intervals.

Results

- Average VOC results for all 22 wells sampled show an overall 52% reduction following the last application.
- Project ongoing.

IN-SITU OXIDATIVE TECHNOLOGIES, INC.
WWW.INSITUOXIDATION.COM

ISOTEC Case Study No. 39

ISCO Treatment Program: VOC Impacted Bedrock

Truck Maintenance Facility
Central New Jersey

INTRODUCTION/ SITE BACKGROUND

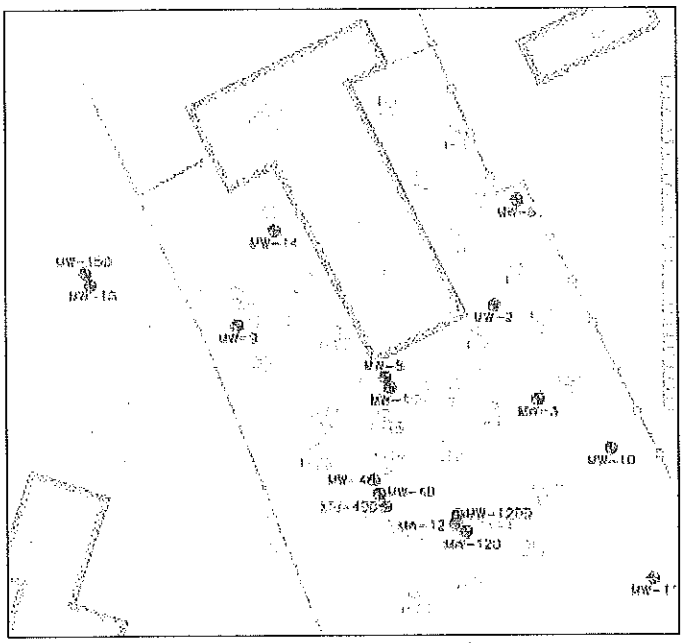
The site is an active Truck Maintenance Facility. Past operations at the site have included storage, maintenance and/or cleaning of trucks since the 1960's. Contaminants of concern at the Truck Maintenance Facility site are volatile organic compounds (VOCs), primarily trichloroethene (TCE), tetrachloroethene (PCE), vinyl chloride (VC), 1,1-dichloroethene (1,1-DCE), chloroform (CF), carbon tetrachloride (CT), benzene and 1,1,1-trichloroethane (1,1,1-TCA). High concentrations of VOCs present at the site indicated the presence of DNAPLs in portions of the site. The VOC plume is centered around the location of a former trench drain. Average concentrations of total VOCs detected in groundwater prior to in-situ chemical oxidation (ISCO) remediation were as high as high as 196,000 micrograms per liter (ug/l) in MW-4, with individual contaminants as high as 100,000 ppb (TCE). Past remedial activities included excavation of contaminated soil down to the top of the weathered bedrock in the suspected source area.

GEOLOGY

Site is underlain by shale of the Passaic formation. Competent bedrock is overlain by up to 10 feet (ft) of unconsolidated materials consisting of in-place weathered bedrock, silt and clay, as well as as some reworked local soil. Groundwater was encountered at approximately 6 ft below ground surface (bgs). General groundwater flow direction is undetermined.

ISCO TREATMENT PROGRAM AND IMPLEMEMENTATION

The ISCO treatment program was completed as an interim remedial measure (IRM) targeting a portion of the on-site plume where total VOC concentrations in groundwater exceeded 10,000 ug/l. The target treatment area consisted of an approximately 415 ft x 275 ft area (see figure below). The target vertical treatment zone covered the 10 to 100 ft bgs depth interval. Thirty (30) permanently installed injection well (IW) clusters consisting of 30 shallow (screened from 10-50 ft bgs) and 30 intermediate/deep wells (screened from 60-100 ft bgs) were installed at a spacing of 40 ft to deliver the ISCO reagents into the fractured bedrock.



The ISCO treatment program designed for the site consisted of a combination of technologies to be delivered into the fractured bedrock for VOC remediation. The primary ISCO technology utilized at the site consisted of a patented modified Fenton's reagent (MFR) treatment followed by an activated catalyzed sodium persulfate (CSP) treatment. MFR was injected first to desorb as much contamination from the bedrock and destroy as much DNAPL as possible. Desorption processes caused by the MFR treatment converted the mass to dissolved phase where it was more readily oxidized by both MFR and CSP reagents.

Two ISCO treatment events (Events I and II) targeting the entire 10,000 ug/l plume have been completed thus far with each event lasting between 5-6 weeks to complete. During Event I approximately 8,705 gallons of MFR were injected into the 30 well clusters followed by injection of approximately 9,000 gallons of CSP. Event II focused on the same 30 well clusters with slightly larger injection volumes. Approximately 9,000 gallons of MFR were injected followed by injection of approximately 10,050 gallons of CSP. Typical injection presures noted at the site ranged from 10-60 pounds per square inch (psi) for most of the IW's with some requiring slighly higher injection pressures in the 70-90 psi range.

	Event I	Event II
MFR Treatment	8,705 Gallons	9,980 Gallons
Catalyst Volume	2,900 Gallons	3,300 Gallons
H2O2 Volume	5,805 Gallons	6,680 Gallons
CSP Treatment	9,000 Gallons	10,050 Gallons
Catalyst Volume	3,000 Gallons	3,350 Gallons
NA2S2O8 Volume	6,000 Gallons	6,700 Gallons

RESULTS

Treatment Program results indicated an average VOC reduction of 52% in the 22 wells sampled following Event II. Average VOC concentration more than doubled from baseline to post-Event I (consistent with the expected desorption/ DNAPL solubilization trend). Following Event II, however, a sharp reduction was noted in average VOC mass from 34,222 ug/l to 7,839 ug/l (>75% reduction) approximately 6 weeks after Event II. Additional treatment applications are being proposed to further reduce the VOC mass/DNAPL that still exists at the site.

ISOTEC

GW VOC Pre vs. Post Treatment Table

Well ID	Baseline VOCs (ug/l)	Post-Event I (6 Weeks) VOCs (ug/l)	Post-Event II (6 Weeks) VOCs (ug/l)	Post-Event II (6 months) VOCs (ug/l)	Overall Reduction (%)
MW-1	18,600	20,000	19,100	20,100	INC
MW-2	12,000	7,850	8,400	4,560	62%
MW-3	3,610	NS	12,500	9,400	INC
MW-4	196,000	229,000	43,400	84,600	57%
MW-5	1,310	2,000	410	203	85%
MW-6	2,220	NS	94	64	97%
MW-7	39	NS	10	11	71%
MW-8	1	NS	ND	0	22%
MW-9	26,200	NS	25,100	241	99%
MW-10	8,810	NS	10,600	12,200	INC
MW-11	810	NS	1,210	881	INC
MW-12	46,700	2,230	25,500	31,600	32%
MW-13	1,740	NS	1,070	1,030	41%
MW-14	28,700	6,810	4,670	4,420	85%
MW-15	21	NS	93	136	INC
MW-4D	41	246	436	80	INC
MW-4DD	2,970	NS	945	679	77%
MW-12D	2,880	NS	2,060	626	78%
MW-12DD	1,670	NS	890	788	53%
MW-13D	9,570	5,640	7,150	4,870	49%
MW-13DD	5,010	NS	794	977	80%
MW-15D	71	NS	181	223	INC
AVERAGE	16,772	34,222	7,839	8,077	52%

Note:

(1) AVERAGE = Average of all 22 wells sampled.

RE: Proposal for Scoping Meeting agenda/schedule
Nancy Fagan to: Matt Brogger/FTEHSF 08/14/2012 11:29 AM
Cc: Frances Verhalen

From: Nancy Fagan/R6/USEPA/US
To: "Matt Brogger/FTEHSF" <MattB@ftpc.fpcusa.com>
Cc: Frances Verhalen/R6/USEPA/US@EPA

Matt,
After the Wednesday meeting (in which Eric will cover the CSM in the expansion area and how it relates to the CSM in the 91 area) , do you envision us working on the following issues on Thursday?
1) I would like to go through the RMP and note areas that need enhancement for the "Revised RMP"
2) In depth discussions on groundwater contaminants (what we are seeing and where) and COC migration over time
3) I would also like to go over the CAOs and discuss the viability of their use at the expansion area.
4) any outstanding issues on SWMUs/AOCs in the expansion area, and any follow-up that is necessary.

Did Eric have any agenda items for Thursday?
Nancy

"Matt Brogger Nancy/Fran 08/14/2012 11:08:45 AM

From: "Matt Brogger/FTEHSF" <MattB@ftpc.fpcusa.com>
To: Nancy Fagan/R6/USEPA/US@EPA, Frances Verhalen/R6/USEPA/US@EPA
Date: 08/14/2012 11:08 AM
Subject: RE: Proposal for Scoping Meeting agenda/schedule

Nancy/Fran

To summarize what we discussed this morning during our conference call:

Fran will arrive at the facility Monday afternoon to get her badge. Fran, please call my cell number when you get close and I will meet you to get your badge so that you do not have to wait. As you drive in front of the plant on FM 1593 you will take the Gate 3 entrance and turn right at the small brick building on your right hand side. This is where my office is located.

We will start Tuesday morning at 8:30 a.m. in the EHS building training room. We will begin with a presentation of the SWMUs and AOCs listed in Exhibit 1, then we can go into the plant and look at them in person. This is so that we can have a chance for discussion inside, versus outside where it can be hard to hear at times. Also, if pictures are needed I will take them and Fran can review them at that time to confirm the photo is accurate. We can make copies of pictures when we return to the office. This is the most efficient way to handle it since I have a camera pass for all areas of the plant.

I will arrange for a light lunch so that we can keep working throughout each day. Nancy will arrive Wednesday afternoon. Nancy, you can call my cell when you get here and I will meet you to get your badge.

I think that covers everything we discussed.

My cell number is (361) 571-0177.

Looking forward to the meeting.

Matt Brogger
Formosa Plastics Corp. TX
EHS Department
Phone: (361) 987-7468
Fax: (361) 987-2363

From: Nancy Fagan [mailto:Fagan.Nancy@epamail.epa.gov]
Sent: Wednesday, August 08, 2012 12:46 PM
To: Matt Brogger/FTEHSF
Cc: Frances Verhalen; Marcia Moncrieffe
Subject: Proposal for Scoping Meeting agenda/schedule

Matt,
This is how EPA envisions our Scoping Meeting, including our schedules:

Frances will arrive on Monday, August 20th and will be ready early Tuesday, the 21st to begin the inspection of the units we described as SWMUS and AOCs, specifically the ones "in question" with regard to the status of the unit (some are "inactive"), location, and wastes managed.
What time should she arrive on Tuesday morning? (the earlier the better to beat the heat!)
We feel that most of Tuesday will be spent on the inspection - this may also run into Wednesday morning.

Wednesday at 2:30 pm, we would like to schedule the corrective action discussion, beginning with your presentation of the conceptual site model for the expansion area and how it relates to the CSM for the area under the 1991 Order. This will be similar to the CSM presentation that we did for the scoping meeting in 2001.

Thursday we would like to wrap up with discussions on the Corrective Action Objectives in the Remedy Decision document (March 11, 2010) and how they "fit" for the entire site - or whether we need to make any necessary changes.

Please let us know if this works for FPC,. After I receive your input, I will follow up with a response to confirm.

Thanks,
Nancy

RE: Proposal for Scoping Meeting agenda/schedule
Matt Brogger/FTEHSF to: Nancy Fagan, Frances Verhalen 08/14/2012 11:08 AM

From: "Matt Brogger/FTEHSF" <MattB@ftpc.fpcusa.com>
To: Nancy Fagan/R6/USEPA/US@EPA, Frances Verhalen/R6/USEPA/US@EPA

Nancy/Fran

To summarize what we discussed this morning during our conference call:

Fran will arrive at the facility Monday afternoon to get her badge. Fran, please call my cell number when you get close and I will meet you to get your badge so that you do not have to wait. As you drive in front of the plant on FM 1593 you will take the Gate 3 entrance and turn right at the small brick building on your right hand side. This is where my office is located.

We will start Tuesday morning at 8:30 a.m. in the EHS building training room. We will begin with a presentation of the SWMUs and AOCs listed in Exhibit 1, then we can go into the plant and look at them in person. This is so that we can have a chance for discussion inside, versus outside where it can be hard to hear at times. Also, if pictures are needed I will take them and Fran can review them at that time to confirm the photo is accurate. We can make copies of pictures when we return to the office. This is the most efficient way to handle it since I have a camera pass for all areas of the plant.

I will arrange for a light lunch so that we can keep working throughout each day. Nancy will arrive Wednesday afternoon. Nancy, you can call my cell when you get here and I will meet you to get your badge.

I think that covers everything we discussed.

My cell number is (361) 571-0177.

Looking forward to the meeting.

Matt Brogger
Formosa Plastics Corp. TX
EHS Department
Phone: (361) 987-7468
Fax: (361) 987-2363

From: Nancy Fagan [mailto:Fagan.Nancy@epamail.epa.gov]
Sent: Wednesday, August 08, 2012 12:46 PM
To: Matt Brogger/FTEHSF
Cc: Frances Verhalen; Marcia Moncrieffe
Subject: Proposal for Scoping Meeting agenda/schedule

Matt,
This is how EPA envisions our Scoping Meeting, including our schedules:

Frances will arrive on Monday, August 20th and will be ready early Tuesday, the 21st to begin the inspection of the units we described as SWMUS and AOCs, specifically the ones "in question" with regard to the status of the unit (some are "inactive"), location, and wastes managed.
What time should she arrive on Tuesday morning? (the earlier the better to beat the heat!)
We feel that most of Tuesday will be spent on the inspection - this may also run into Wednesday morning.

Wednesday at 2:30 pm, we would like to schedule the corrective action discussion, beginning with your presentation of the conceptual site model for the expansion area and how it relates to the CSM for the area under the 1991 Order. This will be similar to the CSM presentation that we did for the scoping meeting in 2001.

Thursday we would like to wrap up with discussions on the Corrective Action Objectives in the Remedy Decision document (March 11, 2010) and how they "fit" for the entire site - or whether we need to make any necessary changes.

Please let us know if this works for FPC,. After I receive your input, I will follow up with a response to confirm.

Thanks,
Nancy

Proposal for Scoping Meeting agenda/schedule

Nancy Fagan to: MattB 08/08/2012 12:46 PM
Cc: Frances Verhalen, Marcia Moncrieffe

From: Nancy Fagan/R6/USEPA/US
To: MattB@ftpc.fpcusa.com
Cc: Frances Verhalen/R6/USEPA/US@EPA, Marcia Moncrieffe/R6/USEPA/US@EPA

Matt,
This is how EPA envisions our Scoping Meeting, including our schedules:

Frances will arrive on Monday, August 20th and will be ready early Tuesday, the 21st to begin the inspection of the units we described as SWMUS and AOCs, specifically the ones "in question" with regard to the status of the unit (some are "inactive"), location, and wastes managed.
What time should she arrive on Tuesday morning? (the earlier the better to beat the heat!)
We feel that most of Tuesday will be spent on the inspection - this may also run into Wednesday morning.

Wednesday at 2:30 pm, we would like to schedule the corrective action discussion, beginning with your presentation of the conceptual site model for the expansion area and how it relates to the CSM for the area under the 1991 Order. This will be similar to the CSM presentation that we did for the scoping meeting in 2001.

Thursday we would like to wrap up with discussions on the Corrective Action Objectives in the Remedy Decision document (March 11, 2010) and how they "fit" for the entire site - or whether we need to make any necessary changes.

Please let us know if this works for FPC,. After I receive your input, I will follow up with a response to confirm.

Thanks,
Nancy

Formosa Plastics®

Formosa Plastics Corporation, Texas
201 Formosa Drive • P.O. Box 700
Point Comfort, TX 77978
Telephone: 361-987-7000

July 27, 2012

Via e-mail and Certified Mail:
7011 0110 0000 1782 6519

Ms. Nancy Fagan
Project Coordinator
6PD-O
U. S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Submittal of Bench-Scale Treatability Testing Work Plan
RCRA Docket No. VI-001(h)-90-H
Section 3008(h) Administrative Order on Consent, as Amended
Formosa Plastics Corporation, Texas
EPA I. D. No. TXT490011293
Solid Waste Registration No. 31945

Dear Ms. Fagan:

In accordance with Section V, Task XI of the modified Corrective Action Plan set forth in Amendment No. 2 to the RCRA Section 3008(h) Order, this letter transmits a Bench-Scale Treatability Testing Work Plan for two areas within the Point Comfort facility. This Work Plan is timely submitted, as it is due 45 days after June 12, 2012, the effective date of Amendment No. 2 to the 1991 EPA Order.

If you have any questions about this submittal, please contact Matt Brogger at (361) 987- 7468 or by e-mail at mattb@ftpc.fpcusa.com.

Sincerely,

R. P. Smith
Vice President/General Manager
Formosa Plastics Corporation, Texas

BENCH-SCALE TREATABILITY TESTING
WORK PLAN
FORMOSA PLASTICS CORPORATION, TEXAS
POINT COMFORT, TEXAS

Prepared for:

FORMOSA PLASTICS CORPORATION
Point Comfort, Texas

July 25, 2012

Prepared by:

PASTOR, BEHLING & WHEELER, LLC
620 E. Airline
Victoria, Texas 77901
(361) 573-6442
Fax: (361) 573-6449

PBW Project No. 3251

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

In accordance with the U.S. Environmental Protection Agency (EPA) Administrative Order on Consent with Corrective Action Plan (CAP) dated February 27, 1991 (EPA Docket No. VI-001(h)-90-H; EPA I.D. No. TXT490011293), as amended, Formosa Plastics Corporation, Texas (FPC-TX) has undertaken measures to characterize and remediate soil and groundwater affected by volatile organic compounds (VOCs) at the Point Comfort facility. The FPC-TX facility is located in Calhoun County along State Highway 35 and Farm to Market Road (FM) 1593, adjacent to Lavaca Bay (Figure 1). The EPA's 1991 Order addresses a facility of approximately 256 acres.

As documented in the Final Risk Management Plan (RMP) (Tetra Tech, 2010), remaining Solid Waste Management Units (SWMUs) and associated potentially impacted soil and groundwater have been segregated into two distinct Areas of Concern (AOC) at the FPC-TX facility: AOC 1 – the former Waste Water Treatment Plant (WWTP) area located in the eastern portion of the site; and AOC 2 – the Vinyl Chloride Monomer (VCM) Process area located in the central portion of the facility. The current estimated extent of each AOC based on current soil and groundwater analytical data is presented on Figures 2 and 3.

This document presents a work plan for conducting a bench-scale treatability study of soil and groundwater from the VCM and former WWTP areas. The study will evaluate the following technologies:

1) In-situ chemical oxidation (ISCO);
2) In-situ biological treatment; and
3) Dual-phase extraction and removal.

Additional detail on the treatability study design is provided in Section 3.0 of this work plan.

2.0 BACKGROUND

Soil and groundwater affected by volatile organic compounds (VOCs) is present at Formosa's Point Comfort facility. A comprehensive summary of existing environmental data was provided in the Areas of Concern Characterization Work Plan (Tetra Tech, 2012) and is not reproduced here. The Final Risk Management Plan (RMP) (Tetra Tech, 2010) also includes a detailed discussion of the nature and extent of potential soil and groundwater impacts and a conceptual site model (CSM). Both of the summaries mentioned above describe the results of the RCRA Facility Investigation (RFI) (C-K Associates, Inc., 1995). Soil sampling has not been conducted at the site since the RFI. Groundwater sampling has been performed on a quarterly basis since 1993.

The main constituent of potential concern (COPC) identified in site soil and groundwater is 1,2-Dichloroethane (EDC). Other chlorinated hydrocarbons are also present in soil and groundwater samples at lower concentrations. There are two main areas at the site with COPCs at elevated concentrations: the former Waste Water Treatment Plant (WWTP) area in the eastern portion of the site and the VCM Process area in the central portion of the site. These areas are shown on Figures 2 and 3 as Areas of Concern (AOC) 1 and 2, respectively.

In the RMP, the Texas Risk Reduction Program (TRRP) protective concentration levels (PCLs) were used as a screening tool and compared to existing soil data. The $^{GW}Soil_{Ing}$ PCL (representing the soil-to-groundwater leaching and potential groundwater ingestion pathway) and the $^{Tot}Soil_{Comb}$ PCL (representing the inhalation, ingestion and dermal contact soil pathways) were identified as the most appropriate screening values. The $^{Tot}Soil_{Comb}$ PCL is generally several orders-of-magnitude higher than the $^{GW}Soil_{Ing}$ PCL for the COPCs at the site. As discussed in the RMP, contaminant concentrations in excess of the $^{Tot}Soil_{Comb}$ PCL were identified in soil samples collected at six SWMUs. Therefore, these areas represent the primary impacted soil areas at the site:

- SWMU #1 – Storm Water Basin;
- SWMU #21/22/23 – Inactive units adjacent to the active incineration area;
- SWMU #3 – Surge Basin; and
- SWMU #4 – Emergency Basin.

Evaluation of the existing soil data for the site also included an analysis of whether the soil samples collected during the RFI were from unsaturated soil or saturated soil. The saturation of the soil is an important factor in the consideration of remedial alternatives for soil since saturated soil is best remediated via groundwater remediation technologies. The analysis of the soil data indicated that the soil samples from the interior of the Surge Basin and Emergency Basin are representative of unsaturated soil

conditions. Coupled with the relatively high concentrations of EDC in the samples from these basins, these locations are considered ideal for collection of soil samples for treatability testing.

In the RMP, groundwater concentration data were evaluated for both elevated concentrations and trends. In the context of this work plan, the trend evaluation is less important than the elevated concentrations, since the treatability tests will be performed on groundwater that currently exhibits elevated COPC concentrations. In the RMP, wells where EDC concentrations in groundwater samples exceed or have exceeded one percent (1%) of the aqueous solubility for EDC (87 mg/L) were identified, as follows:

- P-56 - AOC 1 – WWTP Area, Zone A
- P-57 - AOC 1 – WWTP Area, Zone A
- P-3 - AOC 2 – VCM Area, Zone A
- P-36 - AOC 2 – VCM Area, Zone A
- D-11 - AOC 2 – VCM Area, Zone C
- D-41 - AOC 2 – VCM Area, Zone C
- RD-1 - AOC 2 – VCM Area, Zone C
- RS-1 - AOC 2 – VCM Area, Zone A/B
- RS-6 - AOC 1 – WWTP Area, Zone A
- P-12 - AOC 2 – VCM Area, Zone B
- D-2 - AOC 2 – VCM Area, Zone C
- RS-3 - AOC 2 – VCM Area, Zone A
- RD-3 - AOC 2 – VCM Area, Zone B

Although EDC concentrations, and occasionally chloroform concentrations, exceed 1% of the aqueous solubility limit in some samples, dense non-aqueous phase liquids (DNAPLs) have not been observed in monitoring wells at the site. are wells in DNAPL screened appropriately?

Based on the available information summarized above, the Surge Basin and Emergency Basin areas appear to be the best locations for treatability studies. These areas appear to have the highest COPC concentrations. Furthermore, these locations and are in an easily accessible, inactive portion of the facility. Specific locations for testing are described in Section 3.0.

Summary of Comments on 2012 FPC Treatability Study 072712 fv.pdf

Page: 7

Number: 1 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:29:38 AM
May not have the wells in the DNAPL area. Harder to actually see than LNAPL.

3.0 TREATABILITY STUDY DESIGN

3.1 Introduction

Based on the specific characteristics of the site (e.g., groundwater quality, concentrations of COCs in soil and groundwater, subsurface conditions, logistical issues, etc.), three remediation technologies will be implemented for treatability testing (in-situ chemical oxidation (ISCO), enhanced bioremediation, and multi-phase extraction). These three technologies have the potential to help meet the corrective action objectives (CAOs) and remediation goals for the site.

Depending on the technology, treatability testing can be performed in the laboratory (i.e., bench-scale testing) or in the field (pilot-scale testing). Typically, bench-scale testing is performed first (if feasible). If the bench-scale tests are positive and indicate that a particular technology may be effective at a given site, pilot-scale testing may be warranted. Bench-scale testing was chosen to initially evaluate the ISCO and enhanced bioremediation technologies. Multi-phase extraction is not typically performed at the bench-scale level and should be performed as a pilot-scale test at the site where the COCs are pres[1] in environmental media. Therefore, the multi-phase extraction test will be performed as a pilot-scale test at the FPC-TX site.

The following sections describe the treatability testing program designed to evaluate the selected remediation technologies.

3.2 In-Situ Chemical Oxidation (ISCO)

In-situ chemical oxidation (ISCO) uses strong oxidants to reduce the concentrations of targeted contaminants to acceptable levels. ISCO is accomplished by injecting or otherwise introducing the oxidants directly into the contaminated medium (soil or groundwater) to destroy chemical contaminants in place. Chlorinated ethanes such as EDC are amenable to destruction by chemical oxidati[2] nd ISCO is potentially an effective treatment method for soil and groundwater impacted by EDC at the site.

Chem interferences?
breakdown products?

Page: 8

Number: 1 Author: fverhale Subject: Sticky Note Date: 8/9/2012 8:57:32 AM
Not sure what is meant here. Will there be a separate pilot scale test later using the results of the bench scale test?

Number: 2 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:01:56 AM
How will the chem-ox react with the breakdown products - vinyl chloride? Will there be chemical interferences in the presence of both types of chemicals?

This technology is mainly applicable for saturated media including soil and groundwater; however, in some cases ISCO can be configured to address unsaturated soil by artificially saturating the vadose zone to permit treatment.

Based on the review of potential available oxidant chemistries and the properties of site COPCs, two oxidants were selected for bench-scale testing: (1) modified Fenton's reagent (MFR), and (2) activated sodium persulfate. The sodium persulfate will be evaluated using two activation methods, (1) heat and (2) alkali. A bench-scale test will be performed for each oxidant.

Specific goals of the bench-scale study are to:

- Determine destruction of COPCs for each oxidant;
- Determine whether removal by modified Fenton's reagent is due to destruction or volatilization;
- Evaluate the effect of treatment on secondary water quality parameters;
- Measure soil oxidant demand for activated persulfate (each activator); and
- Estimate the longevity of modified Fenton's reagent in the presence of soil.

Groundwater and soil samples for the ISCO bench scale study will be collected from the WWTP Surge Basin/Emergency Basin area. An evaluation of historic groundwater data indicates that samples from wells P-56 and P-57 (Figure 4) typically exhibit elevated concentrations of EDC and are considered suitable for the treatability testing[1]. Soil samples will be collected using direct-push technology from borings immediately adjacent to wells P-56 and P-57. The soil samples will be collected from the interval approximately 10-14 feet below ground level, which is the interval comprising the Zone A sand at the location of P-56/P-57 (see boring log for well P-56 in Appendix A). More than one boring may be necessary to collect the volume of material needed for the ISCO bench-scale treatability study (as well the material needed for the bench-scale bioremediation study, see Section 3.3). If multiple borings are required, they will be drilled as near as feasible to one another. All borings will be properly plugged and abandoned immediately after the completion of sampling. The soil samples will be collected using standard collection and decontamination techniques that minimize cross-contamination, will be immediately placed on ice for preservation, and shipped to the laboratories using chain-of-custody procedures. Groundwater samples will be collected from well P-56 using the same methods used during the quarterly groundwater monitoring events.

In-Situ Oxidative Technologies, Inc. (ISOTEC) will perform the bench-scale studies on the site soil and groundwater. ISOTECs proposal is included as Attachment B to this work plan. ISOTEC will initially analyze the samples (media appropriate) for VOCs (EDC), sulfate, nitrate, total organic carbon (TOC),

[1] The concentrations of EDC in the samples from P-56 and P-57 were 1,299.7 mg/L and 667.1 mg/L, respectively, in the first quarter 2012 sampling event.

Page: 9

Number: 1 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:02:28 AM
How will artificial saturation occur?

Number: 2 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:03:51 AM
List the COPCs

Number: 3 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:06:45 AM
EDC only? What about concentrations of other VOCs that are present? Vinyl Chloride? Chloroform?

alkalinity, pH, oxidation-reduction potential (ORP), total dissolved solids (TDS) and ferrous iron. The soil and groundwater samples will then be mixed to create soil-slurry samples (in a 2:1 soil to groundwater ratio). A series of reactors (including a control reactor) will be prepared and oxidants will be added at various dosages. At various times during the study, samples will be collected from the reactors and analyzed for EDC and the other parameters. For the MFR, the tests will be conducted for a period of 24-72 hours (or until the residual MFR is consumed). For the persulfate, the test will be conducted for a period of 1-2 weeks. The duration of the test will be dictated by interim sampling results demonstrating destruction of EDC. After the test is concluded, the samples will be quenched to consume the residual oxidant and then analyzed a final time.

ISOTEC will prepare a study report documenting the results of the tests.

3.3 Enhanced Bioremediation

Enhanced bioremediation is a general term used to describe a variety of remedial technologies whereby the natural microbes in the environment are supplemented with additional microbes (bioaugmentation), nutrients, oxygen (aerobic bioremediation) and/or reducing agents (anaerobic bioremediation) to enhance the natural destruction of contaminants. Anaerobic bioremediation (also called reductive dechlorination or bio-chemical reduction) is considered a potential remedial technology for the FPC-TX site since chlorinated hydrocarbons such as EDC are amenable to reductive dechlorination and also for the following reasons:

1) The presence of high ethene concentrations from samples of groundwater from wells P-56 and P-57 may be indicative of the presence of anaerobic microorganisms that have adapted to site conditions and are potentially capable of degrading EDC;
2) The site groundwater exhibits overall reducing conditions (negative ORP values) and near neutral pH which indicates that conditions may be suitable for reductive dechlorination.

As for ISCO, this technology is mainly applicable for saturated media including soil and groundwater; however, in some cases bioremediation can be configured to address unsaturated soil by artificially saturating the vadose zone to permit treatment.

To evaluate the potential for reductive dechlorination to serve as a remedial technology at the site, a bench-scale treatability study has been developed that will use FMC Environmental Solutions (FMC) EHC® technology. EHC technology uses a reagent that includes a controlled-release, integrated carbon (as a nutrient source) and zero-valent iron (ZVI) as a reducing agent to stimulate the reductive dechlorination of chlorinated solvents such as EDC.

As for the ISCO bench-scale study, groundwater and soil samples for the bioremediation bench scale study will be collected from the WWTP Surge Basin/Emergency Basin area. Soil samples will be collected using direct-push technology from borings immediately adjacent to wells P-56 and P-57. The soil samples will be collected from the interval approximately 10-14 feet below ground level, which is the interval comprising the Zone A sand at the location of P-56/P-57 (see boring log for well P-56 in Appendix A). More than one boring may be necessary to collect the volume of material needed for the bench-scale bioremediation study. If multiple borings are required, they will be drilled as near as feasible to one another. All borings will be properly plugged and abandoned immediately after the completion of sampling. The soil samples will be collected using standard collection and decontamination techniques that minimize cross-contamination, will be immediately placed on ice for preservation, and shipped to the laboratories using chain-of-custody procedures. Groundwater samples will be collected from well P-56 using the same methods used during the quarterly groundwater monitoring events.

FMC will perform the bench-scale studies on the site soil and groundwater. FMC's proposal is included as Attachment C to this work plan. FMC will homogenize the soil samples and have the soil analyzed by an outside lab for VOCs (EDC) and pH. The groundwater samples will also be composited and analyzed for VOCs, ferrous iron, sulfate, nitrate, TOC, alkalinity, TDS, pH, and ORP. FMC will then prepare a series of microcosms (ambient, control and EHC) to allow for sampling during the duration of the test (12 weeks or more, depending on interim analytical results collected during the test). If the test results indicate low degradation rates or accumulation of less chlorinated intermediates, bioaugmentation with additional microbes may be implemented.

FMC will prepare a study report documenting the results of the tests.

3.4 Mass Removal Pilot Testing

Dual-phase extraction (DPE) (also called dual-phase recovery) is a proven contaminant mass removal technology for highly contaminated source areas such as those identified at the site. Dual-phase extraction removes contaminants from both groundwater and vadose soils. Extraction from the vadose zone alone is called soil vapor extraction (SVE). Dual-phase extraction can be successful in a low permeable, low yield, heterogeneous formation such as that at the FPC-TX site and can achieve high contaminant mass removal rates. A dual-phase extraction system at the FPC-TX site could potentially remove a substantial portion of the contaminant mass in a relatively short period of time, thus reducing the overall remediation cost.

Number: 1 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:19:41 AM
How will accumulation of less chlorinated intermediates be reported and evaluated? What procedures will be utilized to document bioaugmentation processes?

Number: 2 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:11:56 AM
Zone of influence test, not really a pilot study. Is there a consideration for removal of contaminated soils that are near surface to physically remove the source areas so that this technology will be more effective?

Gainco Inc. (Gainco) will perform mass removal testing by removing soil vapor and groundwater from the subsurface by means of a vacuum. Gainco's proposal is included in Attachment D to this proposal and describes the specific testing procedures to be employed. The duration of the DPE event will be approximately two days. The test will be performed at the well cluster including P-56, P-57 and RS-6. Because the wells in this well cluster are relatively close together (less than 20 feet from one another), an additional temporary well will be installed to evaluate the radius of influence of the vacuum. The well will be installed using a geoprobe and will be constructed with 10-feet of screen, pending field observations during drilling. For the DPE testing, Gainco will provide mobile equipment powered by a self-contained power source. Gainco will supply the appropriately sized high vacuum extraction equipment (e.g., liquid ring pump) capable of removing vapor and affected groundwater from the wells. The DPE pilot test activities will be performed in a series of step tests in recovery well RS-6, with test monitoring conducted in wells P-56, P-57, and the temporary well. The first stage of the test will be dedicated to the evaluation of soil vapor extraction (SVE). A vacuum will be placed on the well for approximately four hours with the wellhead vacuum incrementally increased and then stabilized, based on field conditions. Stage 2 of the test will evaluate the rate of groundwater extraction at RS-6 by placing an adjustable, perforated "stinger" inside the sealed wellhead and placing a vacuum on the well. The third stage of testing will include a12-hour DPE step test. During the step testing, the following parameters will be observed and recorded:

- Groundwater recovery rate;
- Soil vapor recovery rate and temperature;
- Wellhead vacuum at the RS-6 and the monitoring points;
- Depth to water in the selected monitoring points;
- VOC concentration in recovered groundwater and soil vapor; and
- Background depth to water, if practical.

DPE equipment will be equipped with off-gas treatment (carbon), and recovered fluids will be temporarily stored on-site in containers provided by Formosa.

Gainco will provide a summary re[1]that will include the pilot test data, analysis, and results. The report will include the estimated amount of hydrocarbon removed, soil vapor and groundwater recovery rates, hydraulic characteristics, subsurface vacuum profile, and a general evaluation of the viability of the SVE or DPE technology as remedial options for the site.

Number: 1 Author: fverhale Subject: Sticky Note Date: 8/9/2012 9:14:53 AM
Why is this estimated? Samples can be collected at the start and end of the trial period so that actual information is reported.

Also, why are hydrocarbons being considered? It would be preferable to test for the VOCs present.

3.5 Documentation and Reporting

Field activities will be documented by logging events on a Daily Field Record and by collection of photographs. Boring logs will be prepared for each boring installed, including lithologic descriptions of the soils observed. Chain-of-custody forms will be used to document sample shipping and custody. Each vendor will prepare a study report describing the test procedures and results, including all analytical data from the testing. The vendor reports will be appendices to a Bench-Scale Treatability Study Report that will summarize the results of the study.

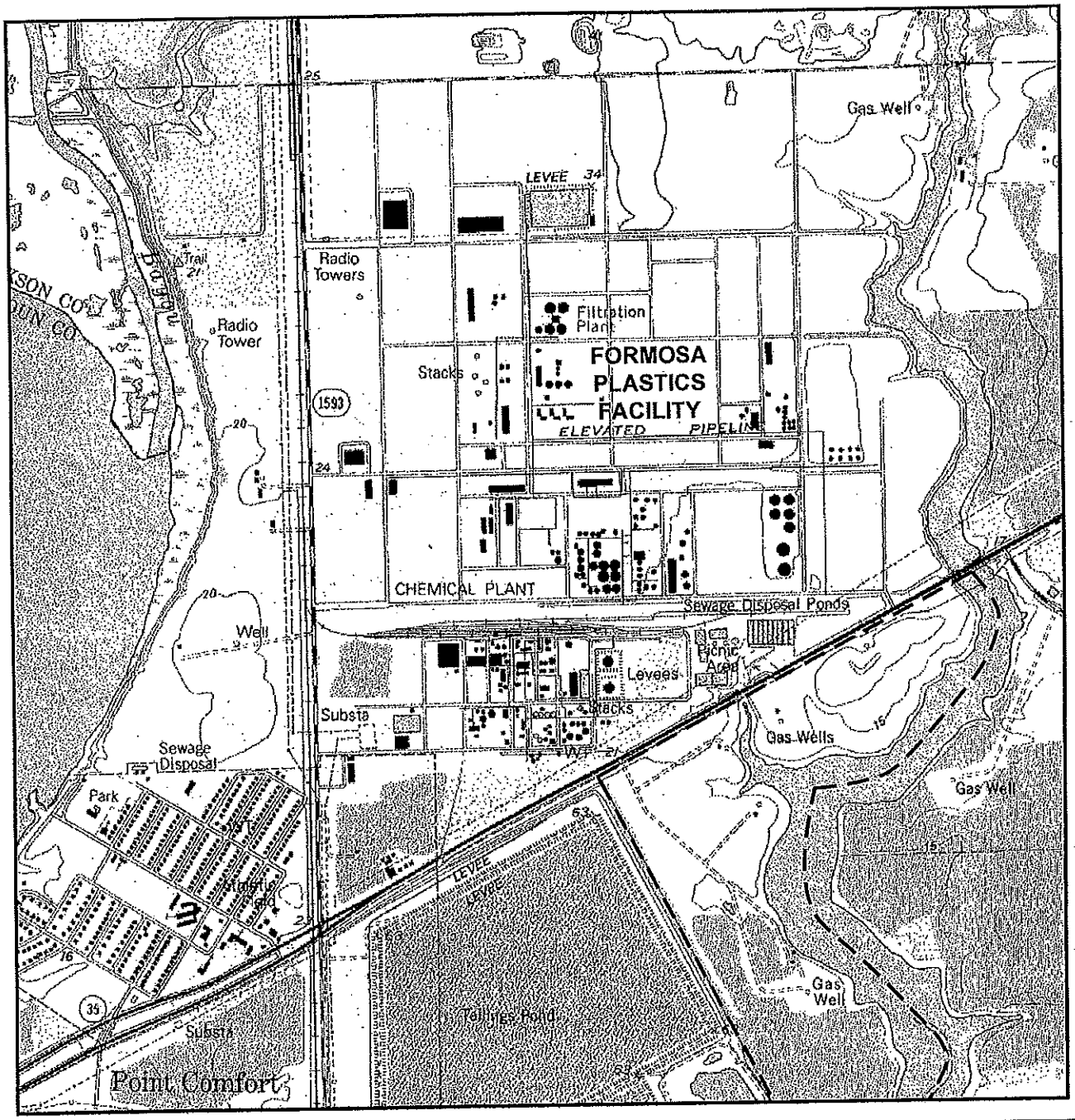
4.0 REFERENCES

C-K, 1995. C-K Associates, Inc. Supplemental RCRA Facility Investigation. June. Revised May 1998.

Tetra Tech, 2010. Tetra Tech, Final Risk Management Plan. April 30.

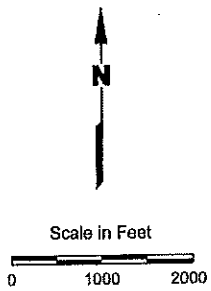
Tetra Tech, 2012. Tetra Tech, Areas of Concern Characterization Work Plan. May 4.

FIGURES



Contour Interval = 5 Feet

QUADRANGLE LOCATION



Source:
Base map from Point Comfort, Texas 7.5 min. U.S.G.S. quadrangle (1995).

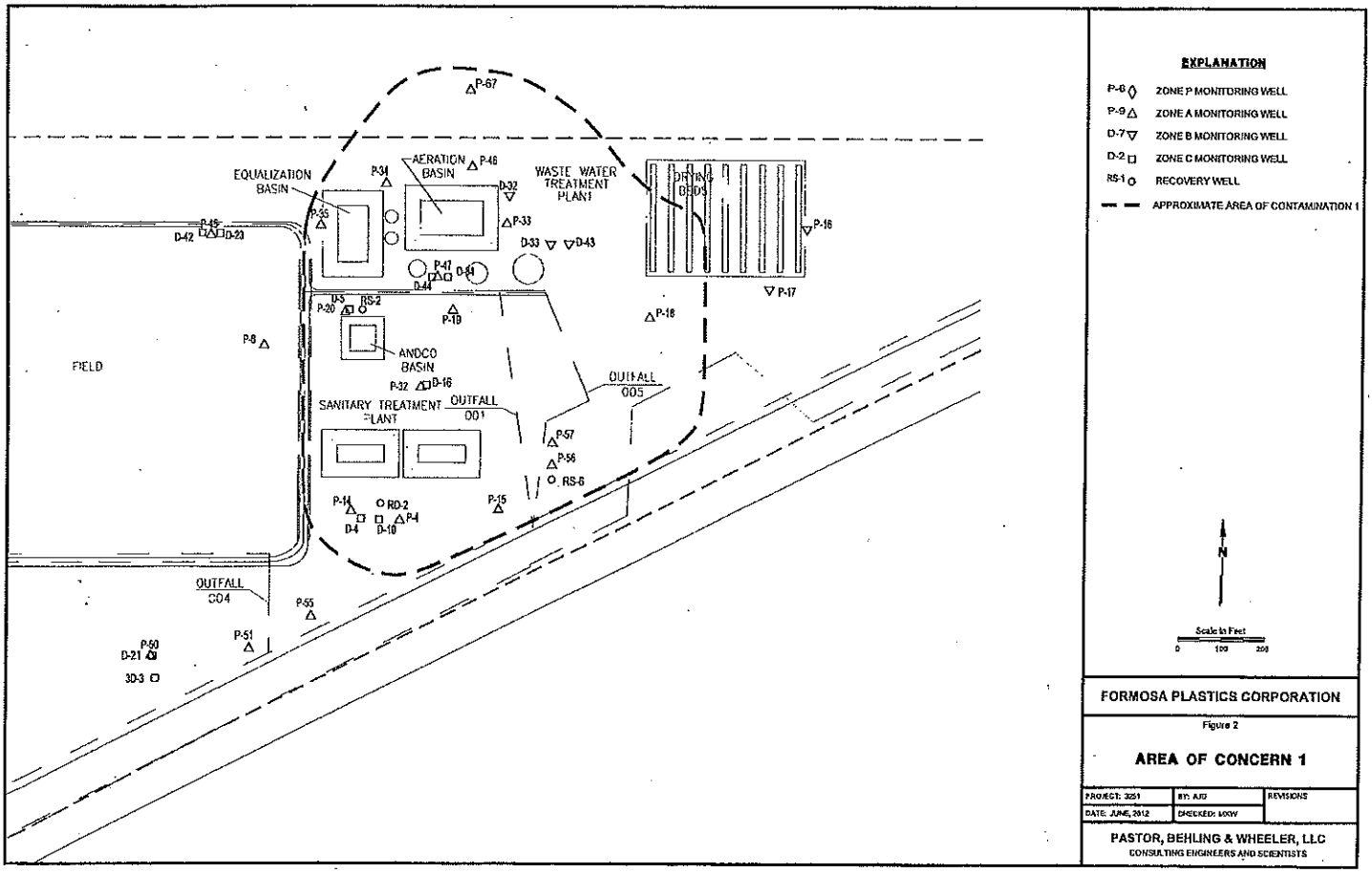
FORMOSA PLASTICS CORPORATION

Figure 1

AREA LOCATION MAP

PROJECT: 3251	BY: AJD	REVISIONS
DATE: JUNE, 2012	CHECKED: MKW	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



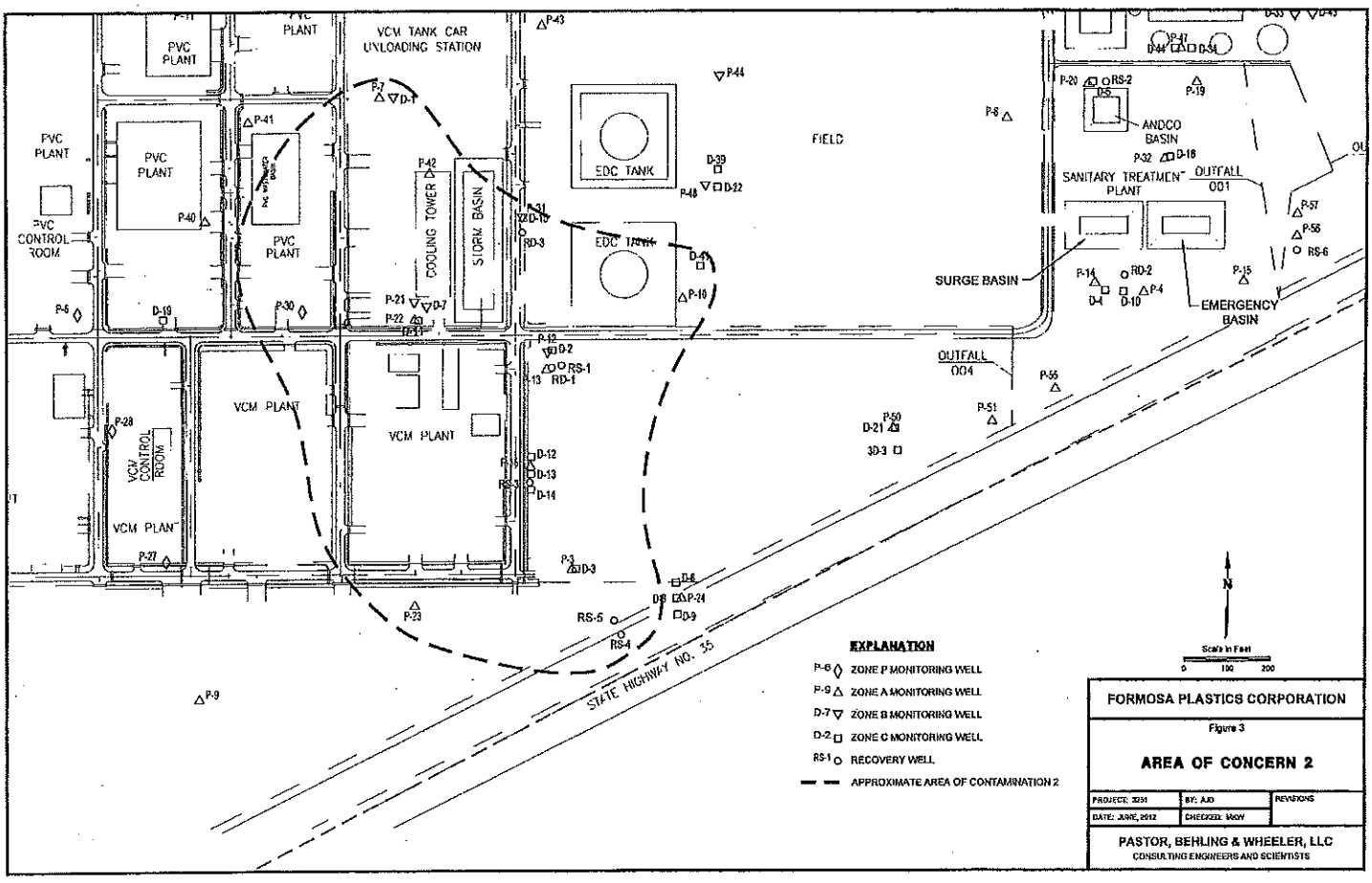
FORMOSA PLASTICS CORPORATION

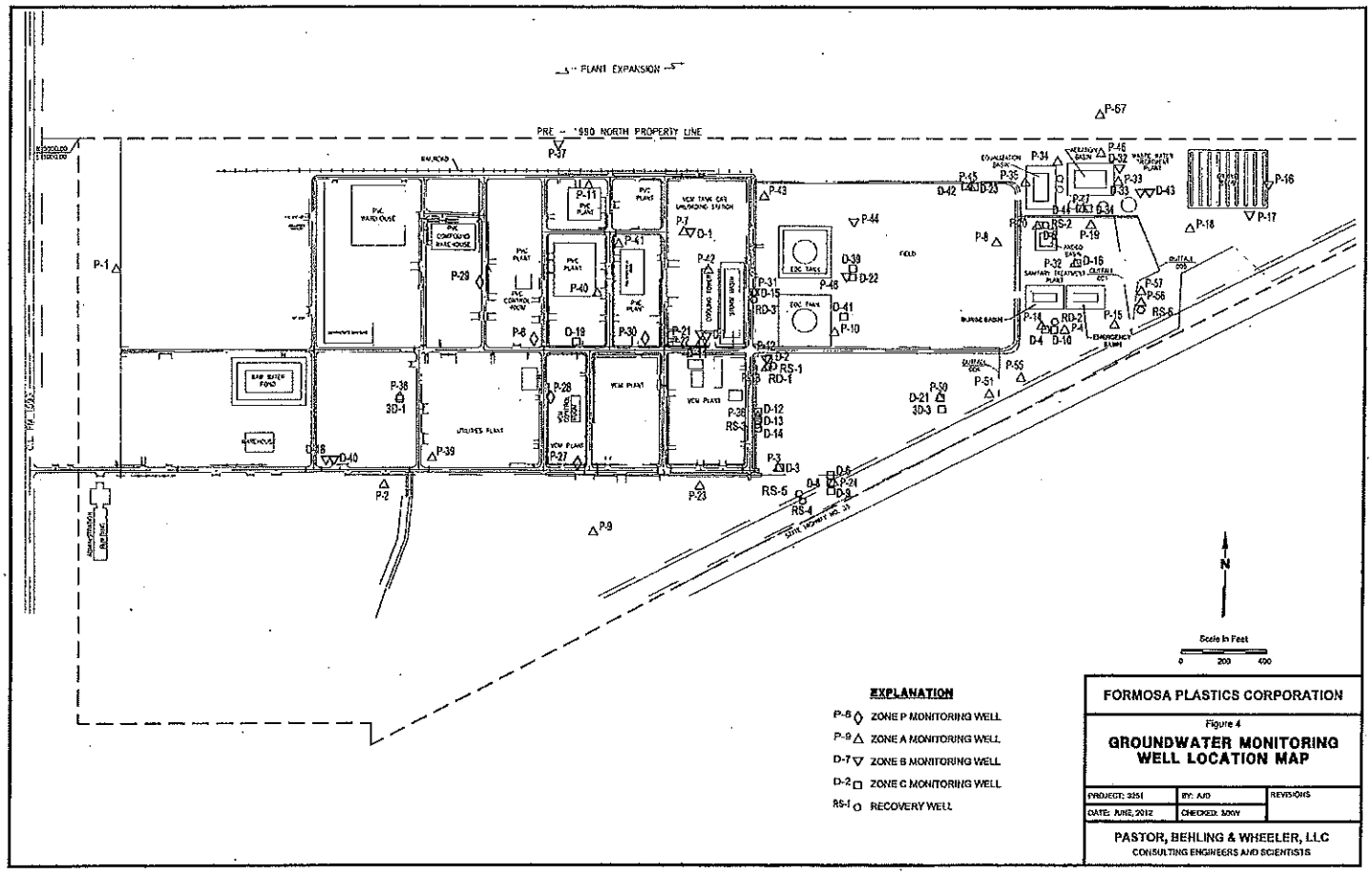
Figure 2

AREA OF CONCERN 1

PROJECT: 3251	BY: AJG	REVISIONS
DATE: JUNE, 2012	CHECKED: MKW	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS


PVC PLANT
VCM TANK CAR UNLOADING STATION
FIELD
EDC TANK
COOLING TOWER
STORM BASIN
SURGE BASIN
ANDCO BASIN
SANITARY TREATMENT PLANT
OUTFALL 001
OUTFALL 004
EMERGENCY BASIN
VCM PLANT
VCM CONTROL ROOM
PVC CONTROL ROOM
STATE HIGHWAY NO. 35
EXPLANATION
P-6 ZONE P MONITORING WELL
P-9 ZONE A MONITORING WELL
D-7 ZONE B MONITORING WELL
D-2 ZONE C MONITORING WELL
RS-1 RECOVERY WELL
APPROXIMATE AREA OF CONTAMINATION 2
N
Scale in Feet
0 100 200
FORMOSA PLASTICS CORPORATION
Figure 3
AREA OF CONCERN 2
PROJECT: 3231
BY: AJO
REVISIONS
DATE: JUNE, 2012
CHECKED: MGW
PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- P-6 ◇ ZONE P MONITORING WELL
- P-9 △ ZONE A MONITORING WELL
- D-7 ▽ ZONE B MONITORING WELL
- D-2 □ ZONE C MONITORING WELL
- RS-1 ○ RECOVERY WELL

FORMOSA PLASTICS CORPORATION

Figure 4

GROUNDWATER MONITORING WELL LOCATION MAP

PROJECT: 3251	BY: AJD	REVISIONS
DATE: JUNE, 2012	CHECKED: SKW	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

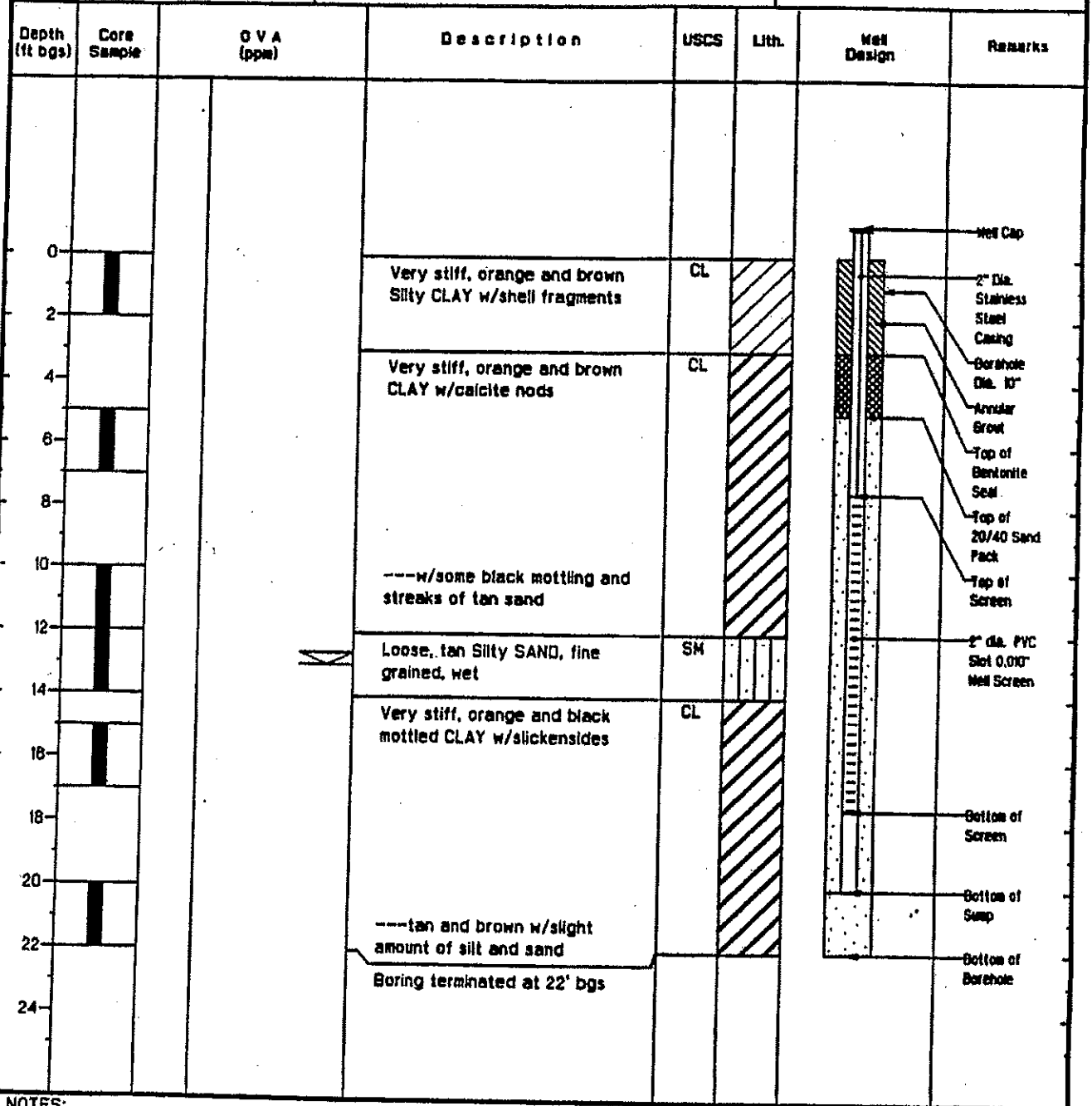
APPENDIX A

Boring Log P-56 for Well

C-K ASSOCIATES, INC.

SOIL BORING LOG: P-56

CLIENT: Formosa Plastics	LOCATION: Point Comfort, Texas	PROJECT NO.: 28-252
DRILLER: CCI	PROJECT NAME: SRFI	X COORD.: N/A
DATE DRILLED: 11/16/94	DRILLING METHOD: Hollow-Stem Auger	Y COORD.: N/A
TOTAL DEPTH: 22.0	WATER LEVEL (I): 13.0	WATER LEVEL (S): N/A
LOGGED BY: M. McDonald	SURFACE ELEVATION: N/A	TOC ELEVATION: 14.55



NOTES:

Approved: SEW

Initial Water Level
Static Water Level

Hand Grab
Shelby Tube
Split Spoon
No Recovery

STDLOG

APPENDIX B

ISOTEC Proposal - ISCO

In-Situ Oxidative Technologies, Inc.

ISOTEC Proposal #901132B
May 11, 2012

- Proposal requested by: Matt Wickham, Pastor, Behling and Wheeler, LLC
- Site name: Formosa Plastics
- Site location: Pt. Comfort, Texas
- Proposal to conduct a treatability study using ISOTEC's Modified Fenton's Reagent and activated persulfate.

In-Situ Oxidative Technologies, Inc. (ISOTEC) is pleased to submit this proposal to conduct a bench-scale treatability study on samples collected from the Formosa Plastics Pt. Comfort, Texas facility. The contaminant of concern at the site is 1,2-dichloroethane (ethylene dichloride – EDC). The bench-scale testing will evaluate modified Fenton's reagent (MFR) and activated sodium persulfate (ASP), using 2 activation methods – heat and alkali (sodium hydroxide), on soil and groundwater samples collected from the site. Bench study sample collection requirements are attached to this proposal.

Experiments will be performed on soil-slurry samples prepared by combining composited soil material with groundwater samples (typically mixed in a 2:1 ratio of soil to groundwater by weight, unless an alternate ratio is specified). At various times during the study, samples will be analyzed for EDC as well as secondary groundwater quality parameters including sulfate, nitrate, TOC, alkalinity, pH, ORP, TDS and ferrous iron.

Initial Characterization

Prior to any testing the soil and groundwater received will be analyzed, media appropriate, for VOCs (EDC, sulfate, nitrate, TOC, alkalinity, pH, ORP, TDS and ferrous iron.

Modified Fenton's Reagent Treatability Study

MFR consisting of stabilized hydrogen peroxide and chelated iron catalyst will be used as the oxidant for the experiments. The samples will be subjected to a series of tests to determine if MFR can successfully treat the EDC. The experiments will be set up in a total of 4 reactors, with one reactor serving as control and the rest serving as treatment reactors. Three different dosages of MFR will be evaluated with the actual initial dosage to be determined based on the concentrations of EDC detected in the sample. The control reactor will undergo the same treatment conditions as the treatment reactors and will receive equivalent volume of deionized distilled water (DI water) to account for dilution due to reagent addition to the treatment reactors. The contents of each reactor will be allowed to react for a period of 24-72 hours (or until residual peroxide is consumed)

6452 Fig Street, Suite C, Arvada, Colorado 80004
Phone: 303-843-9079 Fax: 303-843-9094

Page: 23

Number: 1 Author: fverhale Subject: Sticky Note Date: 8/9/2012 7:50:26 AM
What about other VOCs? The samples from P-56 have very high detection levels and are likely masking the actual concentrations of some of the VOCs.

Number: 2 Author: fverhale Subject: Sticky Note Date: 8/9/2012 7:44:34 AM
Does this dilution affect the concentration of EDC in the sample? Is there a washing effect associated with addition of the reagent such that there is no actual chemical reaction - merely migration from one area to another?

following which, the samples from the control and treatment reactors will be quenched to consume residual oxidant.

Following quenching, the samples are submitted for EDC analysis by EPA Method 8260. The treatment effectiveness will be evaluated by comparing the treatment reactor results with the control reactor results. In addition to the EDC analysis, samples will be analyzed for pH, ORP, TDS and ferrous iron.

Activated Sodium Persulfate Treatability Study

Sodium persulfate will be used as the oxidant for the experiments. Two methods of persulfate activation will be evaluated – alkali (sodium hydroxide) and heat. Three different dosages of ASP-alk, ASP-heat will be evaluated. The samples will be subjected to a series of tests to determine if persulfate can successfully treat the EDC. The experiments will be set up in a total of 6-8 reactors, with one reactor serving as control and the rest serving as treatment reactors. For each method of activation of persulfate tested on the experimental sample, 3 different persulfate dosages will evaluated with the actual initial dosage to be determined based on the concentrations of EDC detected in the sample. The control reactor will undergo the same treatment conditions as the treatment reactors and will receive equivalent volume of deionized distilled water (DI water) to account for dilution due to reagent addition to the treatment reactors. The contents of each reactor will be allowed to react for a period of 1-2 weeks following which, the samples from the control and treatment reactors will be quenched to consume residual oxidant.

Following quenching, the samples are submitted for EDC analysis by EPA Method 8260. The treatment effectiveness will be evaluated by comparing the treatment reactor results with the control reactor results. In addition to the EDC analysis, samples will be analyzed for pH, ORP and TDS.

Number: 1 Author: fverhale Subject: Sticky Note Date: 8/9/2012 7:42:48 AM
quenched wth what? and when - after the sample is collected or in the reactor vessel?

APPENDIX C

FMC Proposal – Enhanced Bioremediation

FMC
ENVIRONMENTAL SOLUTIONS

Via Email: matt.wickham@pbwllc.com; tim.nickels@pbwllc.com

July 12, 2012

PASTOR, BEHLING & WHEELER, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, Texas, 78664
512-671-3434 Tel
512-671-3446 Fax

Subject: Bench Study evaluating an ISCR Technology (EHC®)
Formosa Plastics Corporation, Point Comfort, Texas
Technical Proposal #: FA12-233 Technical

Dear Mr. Wickham and Mr. Nickels:

FMC Environmental Solutions has prepared the following proposal for a groundwater and soil treatability study to evaluate an ISCR technology for the treatment of 1,2-dichloroethane (1,2-DCA). The testing will be performed at the FMC Environmental Solutions laboratory near Toronto, Ontario, with impacted groundwater and soil from the Site.

PROCEDURE

TASK 1: SAMPLE PREPARATION AND INITIAL CHARACTERIZATION

Soil and groundwater samples will be collected from the site, at the client's expense, and will be shipped to our laboratory. Ideally, soil and groundwater samples should be collected from the impacted area being considered for remediation. Approximately 10 Kg of soil and 20 L of groundwater will be required. Upon approval of this proposal, guidelines for shipping the samples to our laboratory will be provided.

The impacted soil sample will be homogenized and particles greater than 4 mesh or 4.75 mm (i.e., debris, gravel, rocks) will be removed. This work will be conducted on the bench top as quickly as possible to minimize exposure to air. The homogenized impacted soil will be sampled for volatile organic compounds (VOCs; Method 8260) and pH.

Prior to testing, the groundwater received in multiple containers will be composited and homogenized by transferring (via gravity) into a Tedlar collapsible bag. This work will be conducted on the bench top as quickly as possible to minimize exposure to air. The composite groundwater will be sampled for VOCs (Method 8260), ferrous iron , sulfate

(Method 375.4), nitrate (Method 353.2), total organic carbon (TOC), alkalinity, total dissolved solids (TDS), pH and oxidation reduction potential (ORP).

The soil and groundwater samples will be shipped on ice under standard chain of custody to TestAmerica (Chicago, IL). The pH and ORP will be measured at the FMC Environemntal Solutions laboratory. The remaining soil and groundwater samples will be placed into cold room storage (4°C in the dark) until required for testing.

TASK 2: Evaluation of ISCR (EHC)

Two controls (water and ambient) and one EHC treatment will be set up with the homogenized soil and groundwater samples in glass bottles (250 mL) using a soil to groundwater ratio of approximately 1:3. Larger (1 L) microcosms will be set up for the final sampling event to allow for analysis of additional parameters. Four jars will be set up for each of the three test conditions (water control, ambient control, EHC) to allow for sampling of one sacrificial jar at four different sampling events. One additional microcosm will be set up for the time zero sampling event. The proposal assumes that four sampling events will be completed (4, 8, 12 and to be determined (tbd) weeks). However, the data will be reviewed after each sampling event and depending on contaminant concentrations; the third and fourth sampling event may not be required. A total of 13 sacrificial jars will be set up as outlined in **Table 1**.

Table 1: Summary of EHC Microcosm Study

Test	Sampling Event	Sampling Time (weeks)	Jar ID
Time Zero (baseline)	0	0	TZ A
Water Control	1	4	WC 1
	2	8	WC 2
	3	12	WC 3
	4	tbd	WC 4
Ambient Control	1	4	AC 1
	2	8	AC 2
	3	12	AC 3
	4	tbd	AC 4
EHC	1	4	EHC 1
	2	8	EHC 2
	3	12	EHC 3
	4	tbd	EHC 4

Further details on each test condition are summarized below:

1. *Water control.* The microcosms will contain groundwater and have zero headspace.
2. *Ambient control.* The microcosms will contain soil and groundwater and have zero headspace.
3. *EHC Microcosms.* The EHC microcosms will contain soil, groundwater and a given mass of EHC. The EHC application rates will be determined once the baseline data is available. The microcosms will have zero headspace.

All microcosms will be stored at ambient temperature and in the dark. At time zero (i.e. 4 hours after set up), the time zero microcosm will be sacrificially sampled. The groundwater will be sampled for VOCs, ORP and pH. The VOCs sample will be submitted to TestAmerica on ice via overnight courier under standard chain of custody. The remaining parameters will be monitored at the FMC Environmental Solutions laboratory using probes.

At predetermined time points (i.e. 4, 8, 12 weeks) one microcosm will be sacrificially sampled from each test condition. The groundwater will be sampled as outlined above for the time zero sampling event. During the last sampling event, the groundwater will also be sampled for sulfate, nitrate, alkalinity, TOC, TDS and ferrous iron. The remaining groundwater in the microcosm will be decanted and the soil will be sampled for VOCs. Samples will be submitted to the appropriate labs as outlined above for the time zero sampling event.

pH?

Bioaugmentation Option

If the week 8 data shows low degradation rates or accumulation of less chlorinated intermediates, bioaugmentation with a commercially available culture may be implemented. This decision will be made in consultation with PASTOR, BEHLING & WHEELER, LLC. The *Dehalococcoides* (DHC) inoculant typically contains a minimum of 5x10E10 cells/L and includes high numbers of *Dehalococcoides* species with known abilities to biodegrade DCE and VC. The recommended target density of DHC cells in the treated aquifer is 5x10E6 cells/L.

FINAL REPORT

Upon completion of the treatability project, FMC Environmental Solutions will draft a final report which will include the following:

A. description of test methods;

B. tabulation of results; and

C. discussion of results.

The draft report will be submitted to PASTOR, BEHLING & WHEELER, LLC for review and comments. FMC Environmental Solutions will incorporate the comments from PASTOR, BEHLING & WHEELER, LLC and issue an electronic version of the final report.

On behalf of FMC Environmental Solutions, thank you for the opportunity to submit this proposal. Please contact me by telephone at 905.273.5374 ext. 232 or by email at eva.janzen@fmc.com if you have any questions regarding this proposal.

Yours truly,

FMC Environmental Solutions

Via e-mail

Eva Janzen
Lab Manager

cc: Philip Block, Josephine Molin – FMC Environmental Solutions

APPENDIX D

Gainco Proposal – Multi-Phase Extraction

GAINCO
ENVIRONMENTAL REMEDIATION

July 12, 2012

Proposal No.: 2139

Mr. Matt Wickham, PG
Pastor, Behling & Wheeler, LLC
620 E. Airline
Victoria, TX 77901

Re: Mass Removal Pilot Testing
Formosa Plant
Point Comfort, TX

Dear Mr. Wickham,

This letter transmits our proposal to you for the above referenced project. Based on information provided, the scope of work generally consists of conducting 1 day of GeoProbe work, installing one monitoring point to be used during the pilot test, subsequently followed by a soil/aquifer pilot test to evaluate mass removal potential of high vacuum extraction..

Geoprobe Work

The GeoProbe investigation will consist of 1 day of probing using direct push technology. Prior to arrival, PBW personnel shall preliminarily locate the borings and obtain clearance from plant personnel for the locations. Based on information provided, it is anticipated that each boring will extend approximately 15-20 feet (ft) below ground surface (bgs), the depth the to the uppermost groundwater-bearing zone. Continuous samples will be obtained using a 5-foot long Dual tube sampler. Samples will be screened and selected by PBW personnel.

Pilot Test Monitoring Point Installation

Prior to conducting the mass removal pilot test, a 2-inch diameter PVC pilot test temporary well will be installed in the near vicinity of the extraction well. We understand the source area of concern for the purposes of the pilot test to be in the proximity of wells P-56, P-57, and RS-6. Prior to arrival, PBW personnel shall preliminarily locate and obtain clearance from plant personnel for the test well location.

Based on information provided, the thin upper groundwater zone is expected to extend from approximately 12 to 14 ft bgs. It is anticipated that the test well will extend approximately 15-20 ft bgs in order to fully penetrate the uppermost groundwater-bearing zone. The screened interval is preliminarily estimated to be from 10-20 ft bgs and will be confirmed by collaboration between the GAINCO geologist and PBW project manager prior to setting to ensure the screened interval includes the permeable target zone. The test well will be properly plugged and abandoned after completion of the pilot testing.

Pilot Testing

The purpose of the pilot test is to determine if either soil vapor extraction (SVE) or high vacuum dual-phase recovery (DPE) technology is suitable for this site. The test apparatus will consist of a liquid ring pump connected to a 1-inch diameter PVC pipe (stinger) inserted into the extraction well. With the stinger placed above the groundwater level and the annular area between the stinger and the well casing sealed, baseline SVE data is collected. Baseline groundwater extraction data is collected by lowering the stinger into the groundwater with the annular area open. By sealing the annular area with the stinger below the groundwater level, high vacuum DPE is conducted, resulting in a data set which can be compared to the two baseline data sets.

The pilot test will be conducted over 2-days, with the SVE and baseline groundwater extraction data collected the first day and high vacuum DPE data collected the second day. It is anticipated the test will be split into stages as described below.

- Stage 1: SVE testing will be conducted for approximately 2-3 hours by stepping up the vacuum incrementally and then holding the vacuum steady, based on field conditions encountered. This short test will provide a baseline for mass removal using SVE only.
- Stage 2: Following SVE testing, the stinger will be lowered to the proximity of the bottom of the extraction well with the annular area open for approximately 1 hour. This short test will provide baseline groundwater extraction data.
- Stage 3: Following the first two stages of testing, DPE testing will be conducted over a period of approximately 6 hours in step fashion and then at a single vacuum, determined based on field conditions encountered.

Prior to testing, PBW shall provide GAINCO with (1) site plans showing site features and well locations, (2) pertinent well and boring logs, and (3) groundwater gauging/sampling data and soil sampling data. Collectively, this information will be used by PBW and GAINCO personnel in determining the most viable array of testing & monitoring wells to be used during the pilot test.

It is our understanding that the recovered groundwater is treated as a listed hazardous waste based on plant protocol. Therefore, the water will be contained in tanks provided by plant personnel pending final disposition by Formosa. Recovered soil vapors will be treated with granular activated carbon (GAC). It is our understanding that waste characterization and disposal (drill cuttings, groundwater, carbon, misc.) shall be conducted by Formosa personnel.

During the testing, the following parameters will be recorded.

- Groundwater recovery rate
- Soil vapor recovery rate and temperature
- Wellhead vacuum at the selected test-well and monitoring points
- Depth to water in the selected monitoring points
- Total volatile hydrocarbons will be recorded during the test with a photoionization detector
- Background depth to water, if practical

Samples of the recovered soil vapor obtained during the SVE and DPE testing will be analyzed for TPH and VOC concentrations. For the purposes of this proposal, we have assumed six sample will be obtained for laboratory analysis.

A report will be prepared to present the pilot test data, analysis, and results. The report will include an estimated amount of hydrocarbons removed, soil vapor and ground water recovery

rates, hydraulic characteristics, subsurface vacuum profile, and a general determination regarding the viability of SVE or DPE technology as remedial options for this site.

Schedule

The GeoProbe investigation will be conducted in one day. The pilot testing activities will be conducted in two consecutive days. We anticipate an additional day will be needed for on-site training and set-up.

If you have any questions or require additional information, please contact either Stas Grover at 210-326-6095 (email: sgrover@gaincoinc.com) or Tom Weber 210-669-8941 (email: tweber@gaincoinc.com).

Sincerely,

Tom J Weber, PE
Gainco, Inc.

ISOTEC Proposal #901132B
May 11, 2012

ISOTEC Laboratory Study Sample Collection

In order to perform an ISOTEC lab study, representative soil and groundwater samples must be collected from an area of concern at the site exhibiting the highest detected levels of contaminants.

Please purge the well prior to groundwater sampling. Field and trip blanks are not required. A summary of the sample containers required for the laboratory study is provided below. **Please contact ISOTEC for sample requirements other than those listed below.**

*****Please ensure zero head space in 1 liter jars and 40 ml vials*****

Test	Container	Volume/ Weight	Matrix	Preservative
Groundwater	1 liter, amber glass (VOCs)	6	Groundwater	Ice, None
Soil	Zip lock bags, Paint Cans	20 lbs	Soil	Ice, None

The samples should be packaged in a cooler (with ice) and shipped overnight (AM) delivery to the following address:

In-Situ Oxidative Technologies, Inc.
11 Princess Road, Suite A
Lawrenceville, New Jersey 08648
Attn: Prasad Kakarla

If you should need to be supplied with sample containers and/or a sample shuttle, please contact ISOTEC at least one week prior to your scheduled sampling date. Please enclose a standard chain-of-custody with the samples. **In addition, please enclose contaminant information by including latest laboratory analytical data on the above samples collected.**

ISOTEC must be notified **at least 48 hours** prior to sample shipment to prepare for lab study.

If you should have any questions concerning the sampling event, please do not hesitate to contact Prasad Kakarla at (609) 275-8500 (ext. 111).

6452 FIG STREET, SUITE C, ARVADA, COLORADO 80004
PHONE: 303-843-9079 FAX: 303-843-9094

1/2

8/14/12

Formosa Treatability

Matt Wickham PBW
Matt Brogger Formosa
Nancy Fagan
Fran Verhab

Linh Nguyen

Treatability Study
M. Wickham
COC = EDC
Tight formation; thin sands; tight clay.
Steam stripping

3 technologies
(1) ISCO (in situ chem ox ⇒ reductive dechlor)
(2) Bioremediation
(3) Multiphase Extraction (SVE/GWE)

ISCOTECH – worked w/ PCE & TCE but can work w/ EDC
FMC – acquired Advertiss recently – Bioremediation
Field? – Pilot Scale Grainco – nearby

Soil/gw collection area ⇒ highest conc & easy access (gw zone A) (soil contam above sat zone but not well defined ⇒ will use sat zone soil)

EDC but also VC, Chloroform issues. Expect treat to reduce all [compd]. Labs sample all 8260 VOCs.

Bioremediation – final testing should include pH?

Summary report for Bench
- evaluate coupling of multiple technology
- outcome is to reduce contaminant mass in source zone
- source trmt will reduce sat zone concent.
- source trmt will reduce vertical migration potential

Article EDC degradation pathways — report w/ flow chart
GWMR Summer 1999

Scoping Meeting
Arrive before 4:30 on Monday
Tuesday 8:00
call Matt
PPT Presentation for each area in Order
Have ~ 8 folks
Lunch brought in

Earplugs
Hardhat
Glasses
Steel toes
Camera

Maureen Hatfield
Eric & Kirk

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

May 7, 2012

Mr. R.P. Smith
Vice President/General Manager
Formosa Plastics Corporation, Texas
P.O. Box 700
Point Comfort, Texas 77978

RE: Approval and Effective Date of the April 11, 2012, Corrective Measures Implementation (CMI) Program Outline for the Administrative Order on Consent, Docket #VI – 001(h)-90-H (1991 AOC)

Dear Mr. Smith,

For settlement purposes, this letter approves the substantive content of the "Proposed Updated Corrective Measures Implementation Program Outline and Schedule" dated April 11, 2012 (Program Outline).[1] This CMI Program Outline supersedes the "Program Management Plan" required under the "Corrective Action Plan", which is incorporated by reference in the 1991 AOC Section V. A., Task XI, Paragraph A.

As discussed during our meeting on May 1, 2012, held at the United States Environmental Protection Agency, Region 6 (EPA) Dallas offices, EPA and Formosa will mutually agree upon the schedule that will govern the timing of the activities described in the CMI Program Outline and incorporate that new schedule in Amendment No. 2 to the 1991 AOC. The substantive content of the CMI Program Outline and its schedule will become effective upon the effective date of Amendment No. 2 to the 1991 AOC.

If you have any questions or concerns, please feel free to contact me at 214.665.8385.

Nancy Fagan

Nancy Fagan

Project Coordinator

cc: Hector Gonzales, Section Manager - Waste
TCEQ Region 14
6300 Ocean Drive, Suite 1200

[1] Normally, the EPA would provide comments to the proposed or draft submittal and Formosa would submit a final Program Outline for approval.

Corpus Christi, TX 78412

Ms. Jacquelyn Rodriguez, MC-127
TCEQ
P.O. Box 13087
Austin, TX 78711-3087

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

April 20, 2012

Mr. R.P. Smith
Vice President/General Manager
Formosa Plastics Corporation, Texas
P.O. Box 700
Point Comfort, Texas 77978

RE: Approval of the CMI Site Management Plan for the Administrative Order on Consent (AOC) Docket #VI – 001(h)-90-H

Dear Mr. Smith,

The purpose of this letter is to formally approve the Final Site Management Plan (SMP) dated February 17, 2012 and received February 22, 2012. This report is the second Corrective Measures Implementation (CMI) workplan that is part of the series of workplans that make up the CMI Program plan. With this approval, it is EPA's expectation to incorporate the SMP into the appropriate sections of the FPC-TX Environmental Manual, as stated in Section 4.0 of the SMP.

If you have any questions or concerns, please feel free to contact me at 214.665.8385.

Nancy Fagan

Nancy Fagan

Project Coordinator

cc: Mr. Brad Genzer
TCEQ Region 14
6300 Ocean Drive, Suite 1200
Corpus Christi, TX 78412

Ms. Jacquelyn Rodriguez, MC-127
TCEQ
P.O. Box 13087
Austin, TX 78711-3087

Formosa Plastics

Formosa Plastics Corporation, America
201 Formosa Drive • P.O. Box 700
Point Comfort, TX 77978
Telephone: (361) 987-7000
Fax: (361) 987-2363

FILE

February 17, 2012

Certified Mail:
7011 0110 0000 1782 5611

Ms. Nancy Fagan
Project Manager
6PD-O
U. S. Environmental Protection Agency, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

RE: Submittal of Final Site Management Plan
RCRA Docket No. VI-001(h)-90-H
3008(h) Administrative Order on Consent
EPA I. D. No. TXT490011293
TCEQ Solid Waste Registration No. 31945

Dear Ms. Fagan:

FPC-TX is in receipt of your letter dated January 20, 2012, received by e-mail on January 20, 2012. This letter contained EPA's comments on the draft CMI Site Management Plan submitted on November 30, 2011 and asked for the incorporation of EPA's comments and the submittal of a Final Site Management Plan within 30 days.

EPA's comments on the draft Site Management Plan have been incorporated as suggested, with the exception of the last two items. As you discussed with Matt Brogger on February 14, 2012, a portion of the comment regarding Land Use Controls seemed overly broad for a plan that is intended to protect workers at the site. We understand that the language we have included in this revised document will satisfy your concern.

To address the comment requesting an overview of the Site Management Plan in site safety meetings, we understand that the language we have included in this document will also satisfy your request. As discussed with Mr. Brogger on February 14, 2012, the requested language seemed very broad, and could lead to confusion on applicable safety requirements. As a matter of practice, FPC-TX routinely conducts safety meetings, but such meetings are specifically focused on the areas where people may be working. Since the Site Management Plan covers certain areas located in the VCM Plant and the former Wastewater Treatment Plant, FPC-TX will provide information on the Site Management Plan to VCM Management, who will then circulate the information to employees and contractors who may work in those areas.

The Final Site Management Plan, which incorporates the EPA comments described above, is enclosed.

If you have any questions on this submittal, please contact Matt Brogger at (361) 987- 7468 or by e-mail at mattb@ftpc.fpcusa.com.

Sincerely,

R. P. Smith
Vice President/General Manager
Formosa Plastics Corporation, Texas

Enclosure: Final Site Management Plan (February 2012)

TETRA TECH

Final

Site Management Plan

Formosa Plastics Corporation
Point Comfort, Texas

February 17, 2012

complex world CLEAR SOLUTIONS™

Final

Site Management Plan

Prepared for:

Formosa Plastics Corporation

Point Comfort, Texas

Prepared by:

Tetra Tech

7800 Shoal Creek Blvd, Suite 253E
Austin, Texas 78757
(512) 338-1667
Fax (512) 338-1331

Tetra Tech Project No. 114-021384

February 17, 2012

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF ACRONYMS

AOC	Area of Concern
CAO	Corrective Action Objective
CAP	Corrective Action Plan
COC	Chemical of Concern
COPC	Chemical of Potential Concern
C_{sat}	Soil Saturation Limit
DQO	Data Quality Objectives
EDC	1,2-Dichloroethane or Ethylene Dichloride
EPA	U.S. Environmental Protection Agency
FM	Farm to Market Road
FPC-TX	Formosa Plastics Corporation, Texas
FSP	Field Sampling Plan
HASP	Health and Safety Plan
NAPL	Non-Aqueous Phase Liquid
NFA	No Further Action
PCE	Tetrachloroethene
PCL	Protective Concentration Level
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RMP	Risk Management Plan
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TRRP	Texas Risk Reduction Program
VCM	Vinyl Chloride Monomer
VOC	Volatile Organic Compounds
WWTP	Waste Water Treatment Plant
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene

1.0 INTRODUCTION AND PURPOSE

Formosa Plastics Corporation, Texas (FPC-TX) owns and operates a chemical manufacturing facility in Point Comfort, Texas. The FPC-TX facility is located in Calhoun County along State Highway 35 and Farm to Market Road (FM) 1593, adjacent to Lavaca Bay (Figure 1). In accordance with the U.S. Environmental Protection Agency (EPA) Administrative Order on Consent with Corrective Action Plan (CAP) dated February 27, 1991 (EPA I.D. No. TXT490011293), FPC-TX has undertaken measures to characterize and remediate soil and groundwater affected by volatile organic compounds (VOCs) at the Point Comfort facility. The EPA 1991 Order is relevant to the area of the FPC-TX facility in operation at the time. Remediation efforts for other portions of the facility (including the expansion areas) are conducted under the jurisdiction of the Texas Commission on Environmental Quality (TCEQ).

The purpose of this document is to provide guidelines and internal procedures for the protection of the on-site worker from contaminants in surface soils, subsurface soils, and groundwater. The following management categories have been addressed as part of the overall site management plan:

- Excavations;
- Industrial Hygiene;
- Indoor Air;
- Land Use Controls; and
- Disposal of Soils.

FPC-TX is an active operating chemical manufacturing facility and as such has existing health and safety systems and protocols developed and implemented in compliance with applicable regulations. These existing systems are adequate to protect the on-site worker from contaminants present in media at the facility and will only be slightly modified to address specific concerns associated with impacted media in affected areas. These modifications are described in Section 3 and consist of:

1. Excavation permits will be required for all excavations in specific affected areas with contaminant concentrations in excess of the Texas Risk Reduction Program (TRRP) $^{Tot}Soil_{Comb}$ protective concentration levels (PCLs). The existing program requires excavation permits if the excavation is expected to be deeper than 19 inches.

This document summarizes the guidelines and internal procedures for the protection of the on-site worker; however, this plan does not replace the FPC-TX Environmental Manual or, Health and Safety Manual, and on-site workers must continue to follow the existing procedures in both manuals. Following EPA's approval of this Site Management Plan, FPC-TX will modify the appropriate sections of the Environmental Manual to incorporate the contents of this plan.

This plan is not intended to address remediation project workers. Extensive soil and/or groundwater remediation projects will require detailed safety plans addressing both physical and chemical hazards that may be encountered during remediation activities.

2.0 AREAS OF CONCERN AND AFFECTED AREAS

As documented in the Risk Management Plan (RMP) (Tetra Tech 2010), potentially impacted soil and groundwater have been segregated into two distinct AOCs at the FPC-TX facility: AOC 1 is the former Waste Water Treatment Plant (WWTP) area located in the eastern portion of the site; and AOC 2 is the VCM Process area located in the central portion of the facility at the eastern edge of the active facility processes. The current estimated extent of each AOC based on current soil and groundwater analytical data is presented on Figures 2 and 3.

2.1 Affected Areas

As described in the RMP, on-site workers may be exposed to impacted groundwater and soil at the site. On-site workers may be exposed to impacted soil in affected areas during routine excavation activities (e.g. excavations to repair water lines). If excavations are advanced into the saturated soil, impacted groundwater could seep into the excavation; however, the Zone A groundwater is approximately 15 feet below the affected areas in the VCM area and 10 feet below grade in the vicinity of the affected areas in the WWTP area. Deep excavations are not considered routine and will not occur in the affected areas for the following reasons:

- As described in detail in Section 2.2 the affected areas in the WWTP area consist of two concrete lined impoundments and are in a non-operational portion of the facility. Other than remediation related activities, there is no reason for any excavation in these areas. As noted in Section 1, this plan is not intended to address remediation project workers. Extensive soil and/or groundwater remediation projects will require detailed safety plans addressing both physical and chemical hazards that may be encountered during remediation activities.

- As described in detail in Section 2.3 the affected areas in the VCM area consist of the Storm Water Basin, and three small, inactive units located in an approximately 3,000 square foot, concrete covered area adjacent to the active incineration area (SWMU 21/22/23).

    - There will be no excavation activities in the Storm Water Basin (SWMU 1).
    - The depth of any potential routine excavations that could occur in SWMU 21/22/23 is limited due to its proximity to other active operational units in the area: excavation to a depth where groundwater would be encountered is not possible at this time.

- Deeper excavations associated with construction of equipment foundations could theoretically occur in these locations in the future, but would not occur until remediation activities were complete or will address remediation as a component of the construction activities.

Groundwater is not used at the facility and should not be encountered during routine excavation, thus on-site worker exposure to groundwater is limited to water removed via the existing eight recovery wells and the associated treatment system.

Soil sampling was performed during completion of the RCRA Facility Investigation (RFI). Sample identification nomenclature as presented in Table 11 of the 1998 Supplemental RFI (C-K Associates, 1998) incorporates the solid waste management unit (SWMU) identification and sample depth, thus, for example, the sample identified as 1E(10-12) is a soil sample collected

near SWMU 1, the storm water basin, at boring location E, at a depth of 10 to 12 feet below the top of the boring. The locations and depths of the soil samples should be considered when evaluating data as the boring elevations from the interior and exterior of the impoundments can vary up to 12 feet. For example, samples identified as 1A(0-2) and 1F(0-2) are both representative of soil samples collected at a depth of 0 to 2 feet below grade at two distinct boring locations near SWMU #1, the Storm Water Basin. In fact though, boring location A is located at the perimeter of the impoundment and boring location F is located at the bottom of the impoundment, approximately 12 feet lower than boring A; thus these two samples represent entirely different soil horizons. Soil samples have not been collected at the site since 1995.

The RMP used TRRP $^{GW}Soil_{Ing}$ and $^{Tot}Soil_{Comb}$ PCLs as a screening evaluation of the existing soil VOC data presented in Table 11 of the 1998 Supplemental RFI. The $^{Tot}Soil_{Comb}$ PCL combines potential risks associated with the inhalation, ingestion, and dermal contact soil exposure pathways, thus represents "direct contact" human health risks. Concentrations of contaminants of concern (COCs) in excess of the $^{Tot}Soil_{Comb}$ PCL may pose risks to industrial workers and construction workers that may come into contact with the impacted soil. This PCL is typically only applied to unsaturated soils up to five feet deep on industrial sites. The $^{GW}Soil_{Ing}$ PCL represents the potential for COCs to leach from soil to groundwater and is based on ingestion of contaminated groundwater. Groundwater at the facility is not used, thus the $^{GW}Soil_{Ing}$ PCL is not used in this document as an indicator of potential worker risk.

The $^{Tot}Soil_{Comb}$ PCL is used in this document to determine the affected area within each AOC where health and safety procedures beyond those already in place at the facility must be applied to ensure protection of on-site workers.

2.2 AOC 1 – WWTP Area

2.2.1 AOC 1 – WWTP Affected Soil Areas

As discussed in the RMP, contaminant concentrations in excess of the $^{Tot}Soil_{Comb}$ PCL were identified in soil samples collected in the vicinity of two AOC 1 SWMUs:

#3 – Surge Basin; and

#4 – Emergency Basin.

A brief description of these areas follows below.

- *SWMU #3 – Surge Basin* - The Surge Basin is located in the eastern part of the facility in the WWTP area on the west side of the Emergency Basin. The Surge Basin is 180 feet long, 120 feet wide and 6 feet deep. It was originally designed as an unlined pond for use as a lime sludge retention basin. FPC-TX lined the basin in 1985. The liner was constructed of 4-inch reinforced concrete underlain by a six-millimeter polyethylene liner and compacted sand backfill (C-K Associates, 1998). The Surge Basin is no longer in service, has been cleaned out and no longer contains solid waste. The base of the Surge Basin is at an elevation of approximately 12 feet MSL. Groundwater elevations in Zone A groundwater, which fluctuates seasonally, is present at a depth ranging from approximately 1.5 to 6 feet below the base of the impoundment, thus approximately 1.5 to 6 feet of unsaturated soil is present below the base of the Surge Basin (Tetra Tech, 2008). EDC concentrations detected in soil samples collected from beneath the base of the basin exceed the $^{Tot}Soil_{Comb}$ PCL and exceed the soil saturation limit (C_{sat}) for EDC.

Soil samples collected from the perimeter of the basin were below the detection limit. The maximum EDC concentration detected in soil at SWMU #3 was 4,800,000 µg/kg [sample 3J (0-2 feet)].

- *SWMU #4 – Emergency Basin* – The Emergency Basin is located on the east side of the Surge Basin in the WWTP area. The Emergency Basin, including the PVC Resin basin is 180 feet long, 120 feet wide, and 6 feet deep. It was originally designed as an unlined pond but was reportedly never used in that condition. FPC-TX lined the basin in 1988. The liner was constructed of 4-inch reinforced concrete underlain by a six-millimeter polyethylene liner and compacted sand backfill (C-K Associates, 1998). The Emergency Basin is no longer in service, has been cleaned out and no longer contains solid waste. The base of the Emergency Basin is at an elevation of approximately 12.8 feet MSL. Zone A groundwater, which fluctuates seasonally, is present at a depth ranging from approximately 2 to 6.5 feet below the base of the impoundment, thus approximately 2 to 6.5 feet of unsaturated soil is present below the base of the Emergency Basin. (Tetra Tech, 2008). EDC concentrations detected in soil samples collected from beneath the base of the basin exceed the $^{Tot}Soil_{Comb}$ PCL and exceed the soil saturation limit (C_{sat}) for EDC. The maximum EDC concentration detected in soil at SWMU #4 was 2,000,000 µg/kg [sample 4I (0-2 feet)R]. Soil samples collected from the perimeter of the basin were below the detection limit with the exception of samples 4A (5-7 feet), 4A (10-12 feet) and 4D (13 feet)R, at 8 µg/kg, 95 µg/kg and 1,600 µg/kg, respectively. Based on the depth of samples 4A (10-12 feet) and 4D (13 feet)R, these samples are likely representative of saturated soil conditions. Sample 4A (5-7 feet) is in the unsaturated zone but the concentration is less than the $^{Tot}Soil_{Comb}$ PCL.

2.2.2 AOC 1 – WWTP Groundwater Recovery Wells

There are two Zone A recovery wells operating in AOC 1: RS-2 and RS-6.

2.3 AOC 2 – VCM Process Area

2.3.1 AOC 2 – VCM Process Area Affected Soil Areas

As discussed in the RMP, contaminant concentrations in excess of the $^{Tot}Soil_{Comb}$ PCL were identified in soil samples collected in the vicinity of two AOC 2 SWMUs:

#1 – Storm Water Basin; and,

#21/22/23 – Holding Pit/Inactive Chemical Sewer Pump/VCM Waste Water Pit.

A brief description of these areas follows below.

- *SWMU #1 – Storm Water Basin* - The Storm Water Basin is located directly north of the VCM processing area on the east side of the cooling tower and has been out of service since 1993. All ancillary equipment has been isolated and all solids have been removed for recycling or disposal. The basin is 230 feet long and 75 feet wide. It was constructed of 4-inch reinforced concrete underlain by a six-mil polyethylene liner and compacted sand backfill (C-K Associates, 1998). The base of the Storm Water Basin ranges from approximately 9 to 12 feet below grade (8 to 11 feet MSL). The majority of the soil samples collected from beneath the base of the impoundment are likely

representative of saturated conditions with the exception of the northern end of the impoundment which may be slightly above the water table. Soil samples that exceed the $^{Tot}Soil_{Comb}$ PCL are 1F (0-2 feet), 1G (0-2 feet), 1G (2-3 feet), and 1I (5-7 feet) at 56,000 µg/kg, 27,000 µg/kg, 28,000 µg/kg and 72,000 µg/kg, respectively; all of these samples were collected from below the base of the impoundment and appear to be representative of the saturated zone (Tetra Tech, 2008). The majority of EDC detections in soil samples collected at perimeter borings are representative of saturated soil conditions. The maximum EDC concentration detected in soil from the perimeter borings was 14,000 µg/kg [sample 1B (18-19 feet)] at the southeast corner of the impoundment. This sample was collected at a depth of 18 to 19 feet below grade, which puts it at an elevation of approximately 1 to 2 feet MSL; near the bottom of the Zone A groundwater bearing unit and clearly in the saturated zone. Only one perimeter soil sample representative of unsaturated soil conditions contained EDC concentrations greater than the detection limit: the EDC concentration detected in soil from the perimeter boring 19D located at the southwest corner of the impoundment was 6,400 µg/kg [sample 19D (5-7 feet)]. This concentration is less than the $^{Tot}Soil_{Comb}$ PCL.

- *SWMUs #21/22/23 – Holding Pit/Inactive Chemical Sewer Sump/VCM Waste Water Pit* – SWMU #21 was the Holding Pit for EDC Decanter Sludge (VT-640). It was built in 1980 and was formerly a part of the waste water recovery system in the VCM Process area. The Holding Pit is an open-top, above-ground concrete pit with side walls approximately four feet high. SWMU #22 is an Inactive Chemical Sewer Sump[1]. The Inactive Chemical Sewer Sump is a small concrete sump with a metal cover. It was part of the chemical sewer system designed to contain spills and other contaminated wastewaters within the VCM Process area. SWMU #23 was the VCM Process Waste Water Collection Pit (VT-630). It was part of the VCM waste water recovery and treatment system. The enclosed concrete pit is partially below grade and pumps and other equipment were situated on top of the pit.

  This SWMU grouping consists of three small, inactive units located in an approximately 3,000 square foot, concrete covered area adjacent to the active incineration area. These units are no longer in service, have been cleaned out and no longer contain solid waste. The Current Conditions Technical Memo (Tetra Tech, 2008) recommended, and EPA approved, that given the close proximity of these SWMUs they should be considered a single area referred to as SWMU # 21/22/23. SWMU #21/22/23 is in an active, congested area of the facility. Although limited soil remediation may be possible in these areas, corrective action is likely to focus on groundwater strategies to manage the groundwater plume associated with these SWMUs without actively remediating the entire area of impacted soil. The maximum EDC concentration detected in soil in this area was 280,000 µg/kg [sample 22B (0-2 feet)]. This was the only sample in the area with an EDC concentration that exceeded the $^{Tot}Soil_{Comb}$ PCL.

[1] The name of this SWMU in historical documentation varies between Sewer Pump and Sewer Sump – it should be referred to as a sump.

2.3.2 AOC 2 – VCM Process Area Groundwater Recovery Wells

There are six recovery wells in AOC 2. Recovery wells RS-1, RS-3, RS-4 and RS-5 in Zone A, recovery well RD-3 in Zone B, and recovery well RD-1 in Zone C. Recovery well RS-1 appears to be screened across both Zone A and Zone B.

2.4 Summary of Affected Areas

2.4.1 Affected Soil Areas

COCs have been detected at concentrations greater that the $^{Tot}Soil_{Comb}$ PCL in soil samples from the following areas:

- AOC 1 – WWTP Area
  - #3 – Surge Basin
  - #4 – Emergency Basin
- AOC 2 – VCM Area
  - #1 – Storm Water Basin
  - #21/22/23 – Holding Pit/Inactive Chemical Sewer Sump/VCM Waste Water Pit

The affected areas are indicated on Figures 2, 3 and 4. Impacted soil associated with the three basins (SWMUs 1, 3, and 4) is located beneath the base of the impoundments, below a concrete liner, and at depths greater than five feet below the surrounding grade. These areas will not be disturbed by typical on-site workers. In the event the corrective action selected for these areas includes active remediation, remediation contractors will be required to prepare detailed health and safety plans addressing both physical and chemical hazards associated with implementation of the corrective action.

Figure 4 indicates a conservative estimate of the potential extent of the affected area at SWMU #21/22/23. As noted above, only the 0 – 2 feet sample collected at boring 22B located near the southern extent of the area contained EDC concentrations in excess of the $^{Tot}Soil_{Comb}$ PCL.

2.4.2 Groundwater Recovery Wells

There are six Zone A, one Zone B, and one Zone C recovery wells operating at the site. On-site workers may be exposed to impacted groundwater during periodic pump and/or treatment system maintenance.

3.0 MANAGEMENT OF AFFECTED AREAS

Site activities that occur within the AOCs require management due to the potential risks to on-site workers from soil or groundwater impacted with site COCs. Each activity has requirements that are unique to complete each task and may require different personal protective equipment (PPE) requirements. The following activities and controls are addressed under this site management plan:

- Excavations;
- Indoor Air;
- Industrial Hygiene
- Land Use Control; and
- Disposal of Soils.

This document summarizes the guidelines and internal procedures for the protection of the on-site worker; however, workers must continue to follow the FPC-TX Environmental Manual and Health and Safety Manual. Following EPA's approval of this Site Management Plan, FPC-TX will modify the appropriate sections of the Environmental Manual to incorporate the contents of this plan.

3.1 Excavations

Permits are issued by FPC-TX for all work that involves removing soil from the ground producing unsupported soil conditions. Per FPC-TX procedures, an Excavation Permit is required when an excavation is 19 inches or more in depth.

For excavations or disturbance of soils at any depth within the affected areas listed in Section 2.4.1 and indicated on Figures 2, 3, and 4, the following procedures should be adhered to:

- An Excavation Permit will be required and issued by FPC-TX personnel;
- Air quality will be constantly monitored with a lower explosive limit (LEL) meter or flame ionization detector (FID) and recorded hourly;
- If air monitoring results exceed values listed in Attachment 1 of the FPC-TX Health and Safety Manual Procedure 15 "Respiratory Protection Program", then a respirator will be required to be worn that is in accordance with the policies set forth in Procedure 15; and
- Removed affected area soil and groundwater will be placed in approved appropriate containers, sampled, and disposed at an approved facility. Appropriate containers may vary depending upon the volume and type of material.

Although groundwater could seep into deeper excavations, as described in Section 2.1 excavations of a sufficient depth to encounter groundwater are unlikely to occur in the affected areas. In the unlikely event groundwater is encountered, on-site workers would follow the FPC-TX Health and Safety Manual Procedure 17, "Personal Protective Equipment."

3.2 Disposal of Soils

Selection of containers for the storage of hazardous or non-hazardous wastes for disposal shall be done in a manner that insures compatibility between the material from which the container is constructed and the waste the container will hold. All soils removed from the affected areas will be sampled and handled in accordance with existing FPC-TX procedures as documented in Environmental Manual Procedure 23, "Waste Analysis Procedure."

A list of container materials compatible for storage of certain types of wastes is included in the FPC-TX Environmental Manual, Procedure 11, "Container Handling and Storage Management."

All hazardous or non-hazardous waste storage areas listed on the FPC-TX Notice of Registration shall be managed according to the EHS Department Solid Waste Section SOP Manual Procedure 4. Containers will be sampled prior to disposal for constituents required by the disposal facility. Ultimately, the Environmental Health and Safety Department will be responsible for the proper and timely disposal of hazardous and non-hazardous waste containers.

3.3 Industrial Hygiene

3.3.1 Personal Protective Equipment

FPC-TX PPE procedures provide policies for head protection, eye and face protection, gloves, and foot protection as well a several other types of PPE. Workers that will contact exposed soils in the affected areas must prepare a task-specific safety plan that addresses physical and chemical hazards. Refer to FPC-TX Health and Safety Manual Procedure 17, "Personal Protective Equipment" for approved PPE, specifically Attachment 12.1, "Hazard Assessment and PPE Selection Guideline."

3.3.2 Flame-Resistant Clothing

Flame-resistant clothing (FRC) will be managed as a mandatory, facility-wide requirement for all FPC-TX employees, contractors, and visitors. This policy will also apply to all affected areas listed in Section 2.4. For additional information regarding FPC-TX's policy on FRC, refer to Health and Safety Manual Procedure 57, "Flame Resistant Clothing".

3.3.3 Respiratory Protection

Employees, contractors, and visitors, must use respirators when atmospheric hazards may exist. The selection of respirators must include the following factors:

- The type of hazard;
- The concentration of the hazard;
- The characteristics of the operation or process;
- The amount of personal exposure time;
- The assigned protection factor (APF) of the respirator used; and
- The maximum concentration of the contaminant in which a particular type of respirator can be used (the Maximum Use Concentration, or MUC).

Air purifying respirators are anticipated to be the only type of respiratory protection that may be required for work associated with the affected areas. Air purifying respirators may be used only in areas where the oxygen content is between 19.5% and 23.5%. When air purifying respirators are used for particulate exposure, cartridge respirators with P-100 series cartridges must be used. Those who use a respirator must be fit tested, medically cleared, and must inspect the respirator before each use.

A list of chemicals inherent to the FPC-TX site along with the OSHA Permissible Exposure Limit (PEL) and Immediately Dangerous to Life or Health (IDLH) atmospheres (in part per million) is provided in Attachment 1 of FPC-TX's Health and Safety Manual Procedure 15 "Respiratory Protection Program."

3.3.4 Training and Safety Plans

FPC-TX has existing training requirements for on-site activities as documented in the FPC-TX Environmental Manual and Environmental Health and Safety Manual. On-site workers that may be exposed to soils and groundwater in affected areas during excavation activities are required to have completed 40 hour HAZWOPER training (OSHA 29 CFR 1910.120) and are required to prepare a task-specific safety plan. Information provided in Table 1 should be considered during preparation of the safety plan.

Although groundwater could seep into deeper excavations, as described in Section 2.1 excavations of a sufficient depth to encounter groundwater are unlikely to occur in the affected areas.

3.4 Indoor Air

Indoor Air concerns have been evaluated using the EPA's OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (EPA, 2002). The Tier 1 – Primary Screen step was used to identify whether or not the potential exists for subsurface vapor intrusion at the FPC-TX site. While the FPC-TX site does have volatile chemicals of concern present in surface and subsurface soils and in shallow groundwater, there are no inhabited buildings located above or in close proximity of the affected areas. Additionally, there are no conditions that warrant immediate actions. There is one control room located to the east of the incinerators that may be located above the impacted Zone A groundwater. The incinerator control room is operated by one employee, and the work consists of a combination of indoor and outdoor activities. The control room operators work on a 28-day, rotating 12-hour shift schedule, and are typically in the actual control room approximately 60% of the time, or approximately 100 non-consecutive hours in a 28-day period. The remaining 40% of their schedule involves activities outside of the control room.

To ensure the protection of human health and the on-site worker, as new data is collected to further characterize the distribution and concentration of contaminants in soil and groundwater in the AOCs, FPC-TX will review the new data and the locations of all occupied structures. In addition, prior to the construction of any inhabited structures in the AOCs, FPC-TX will complete appropriate investigation and modeling of potential vapor intrusion and will take appropriate steps to protect workers by remediating impacted areas prior to construction or incorporating protection into the structural design, i.e. positive pressure inside building and/or venting along foundations.

3.5 Land Use Controls

Land Use Controls include engineering and physical barriers such as fences and security guards, as well as institutional controls (EPA, November 2010). This section is limited to potential land use controls that address worker protection for current operational activities. The entire FPC-TX facility is fenced and the facility has a full-time 24-hour active security force. In general, the affected areas are not located near or in current operational areas of the facility where FPC-TX personnel need access to perform day to day job tasks. All of the areas where COC concentrations exceed the TRRP $^{Tot}Soil_{Comb}$ PCL are beneath existing concrete liners or pavement. Three of the four areas are beneath the concrete base of former impoundments and are not easily accessible. FPC-TX has no plans to implement additional engineering or physical barriers in the AOCs at this time. Land use controls in the form of physical barriers (fences) or engineered controls may be considered in the future for all or portions of the affected areas. For example, additional engineering and/or physical controls will be considered during remediation activities that may expose impacted soils.

Institutional controls (IC) may be required as part of implementation of the final selected corrective action(s), or if site conditions change. For example, IC would be considered if FPC-TX were to sell all or portions of the affected areas to another company. In addition, if additional delineation activities discover that affected groundwater has moved off-site or on a property not owned by FPC-TX, then an IC may be considered for that property: FPC-TX will approach that landowner for the application of an IC on their property if warranted. Institutional Controls, if required, will be implemented in accordance with TRRP 16, "Institutional Controls under TRRP."

4.0 CONCLUSION

FPC-TX is committed to providing a safe and healthy work place. All employees, contractors, and visitors are encouraged to play an active role in the health and safety program set forth by the Environmental Health and Safety Department. In the event there is a Safety and Health issue, FPC-TX has procedures for providing direction and conveying information by utilizing the Safety Council and Employee Monthly Safety Training Meetings.

This Site Management Plan summarizes the guidelines and internal procedures for the protection of the on-site worker; however, workers must continue to follow the FPC-TX Environmental Manual and Health and Safety Manual. Following EPA's approval of this Site Management Plan, FPC-TX will modify the appropriate sections of the Environmental Manual to incorporate the contents of this plan.

5.0 REFERENCES

C-K Associates, Inc., 1998. Supplemental RCRA Facility Investigation, June 1995, Revised May 1998.

Formosa Plastics Corporation, Texas. Environmental Manual.
- Procedure 11, "Container Handling and Storage Management"
- Procedure 23, "Waste Analysis Plan"

Formosa Plastics Corporation, Texas. Health and Safety Manual.
- Procedure 15, "Respiratory Protection Program"
- Procedure 17, "Personal Protective Equipment"
- Procedure 57, " Flame Resistant Clothing"

Tetra Tech, 2008. Memorandum from Eric Klink, Tetra Tech, to Matt Brogger, Formosa Plastics Corporation – Texas, regarding Current Conditions. August 1.

Tetra Tech, 2010. Final Risk Management Plan, April 30.

Texas Commission on Environmental Quality, 2010. TRRP 16: Institutional Control under TRRP. Remediation Division, RG-366/TRRP-16. Revised May.

U.S. Environmental Protection Agency, 2002. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. Office of Solid Waste and Emergency Response, EPA 530-D-02-004. November.

U.S. Environmental Protection Agency, 2010. Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites, Interim Final. Office of Solid Waste and Emergency Response, EPA-540-R-09-001, November.

TABLES

Site Safety Plan - Health and Safety Considerations

The following can be used as a "checklist" of the types of items that must be considered and addressed in Site Safety Plans.

I. JOB/TASK DESCRIPTION:

TASK	PERSONNEL	EQUIPMENT	DURATION
Set equipment required for project into position. Dig excavation hole and trenches	Supervisor Technicians Operator	4-Man Breathing Air Trailer Vacuum Truck Hand Tools 55 gallon drums Confined Space Entry Gear A/C Trailer	

II. A. HAZARD IDENTIFICATION: OCCUPATIONAL HEALTH CONCERNS

CHEMICAL AGENTS	PHYSICAL AGENTS	BIOLOGICAL AGENTS
Ethylene dichloride Benzene Vinyl Chloride	Noise Slips, Trips and Falls Heavy Lifting High Vacuum Equipment Heat Stress	Insects

HEALTH HAZARD EVALUATION

II. B. HAZARD IDENTIFICATION: SAFETY CONCERNS

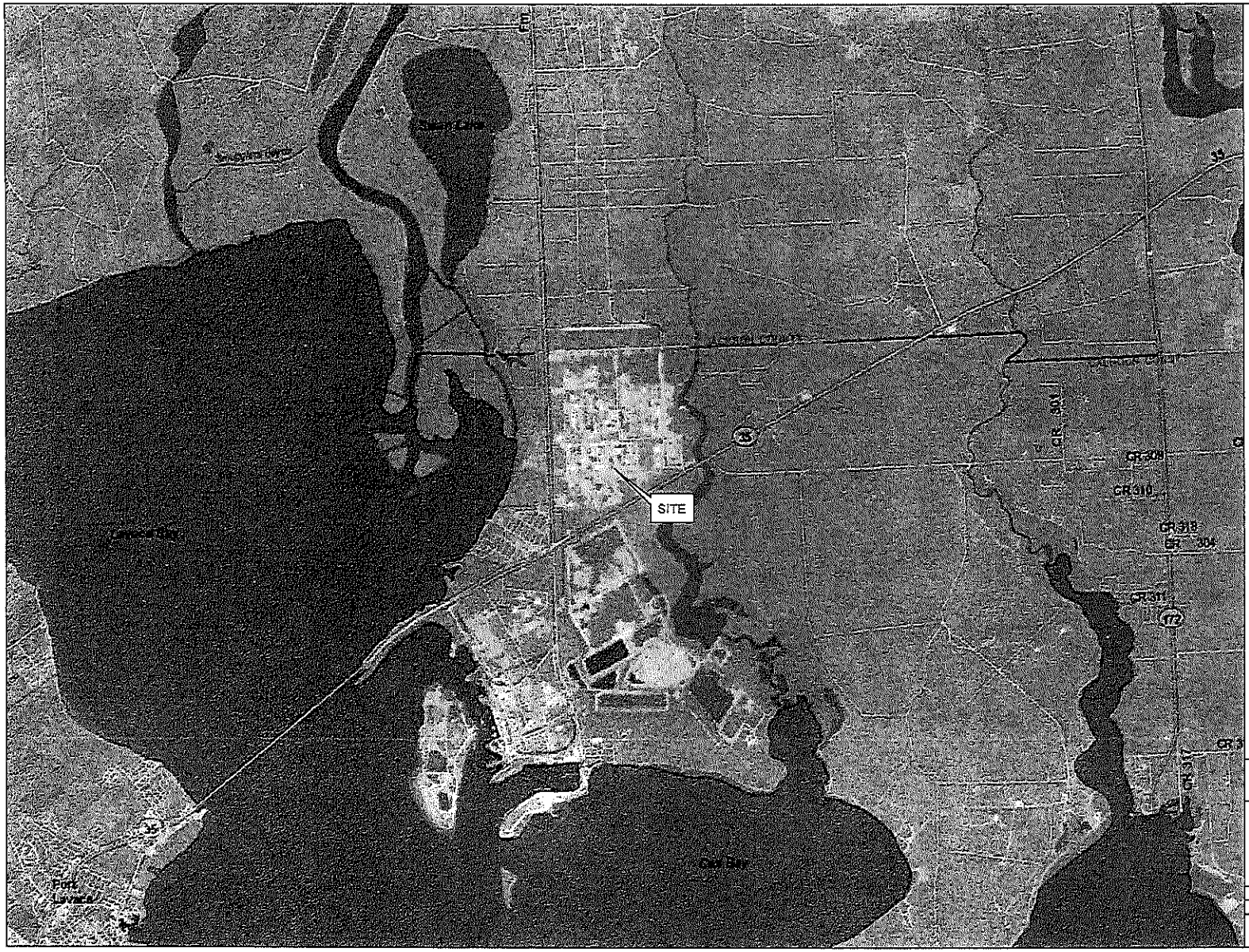
ACTIONS	CONDITIONS	VEHICLE	PROPERTY
Fresh breathing air (supplied) Half-face ov/ag cartridge respirator Full-face ov/ag cartridge respirator Hearing Protection	High noise High vacuum Heat stress	Pickup Truck Vacuum Truck A/C Trailer	Plant equipment Other plant processes Plant traffic

SAFETY EVALUATION

III. JOB HAZARD CONTROL:

ENGINEERING	PPE	TRAINING	DECONTAMINATION	OTHER
Barricade work zone Inspect valves and hoses to manage discharge rate into drums Secure drum stability while loading a transporting	Safety Goggles / Face Shields Hard hats Safety glasses Hard toe footwear, leather and rubbe Hearing protection FR Coveralls and CRFR coveralls Nitrile and leather gloves Half-Face Respirator Full-Face Respirator Breathing Air	40 Hour HAZWOPER 8 HR REFRESHER Formosa Permitting	Remove PPE Properly	Air Monitoring: 4-Gas Meter PID 10.6 ev Lamp Sensidyne tubes

FIGURES



SOURCE: Base map USGS Point Comfort, TX 7.5 minute quadrangle (1995).

FORMOSA PLASTICS CORPORATION

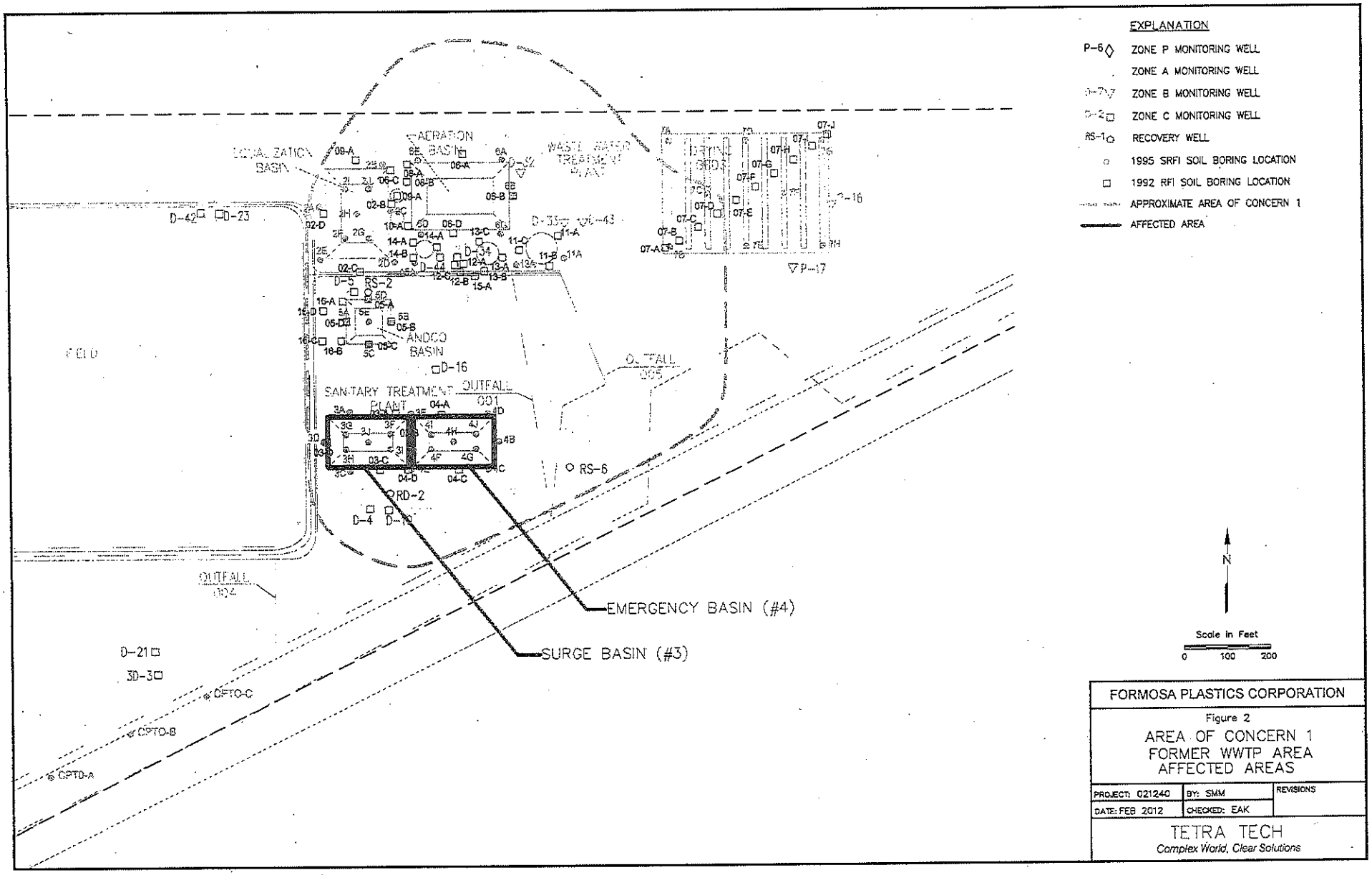
FIGURE 1

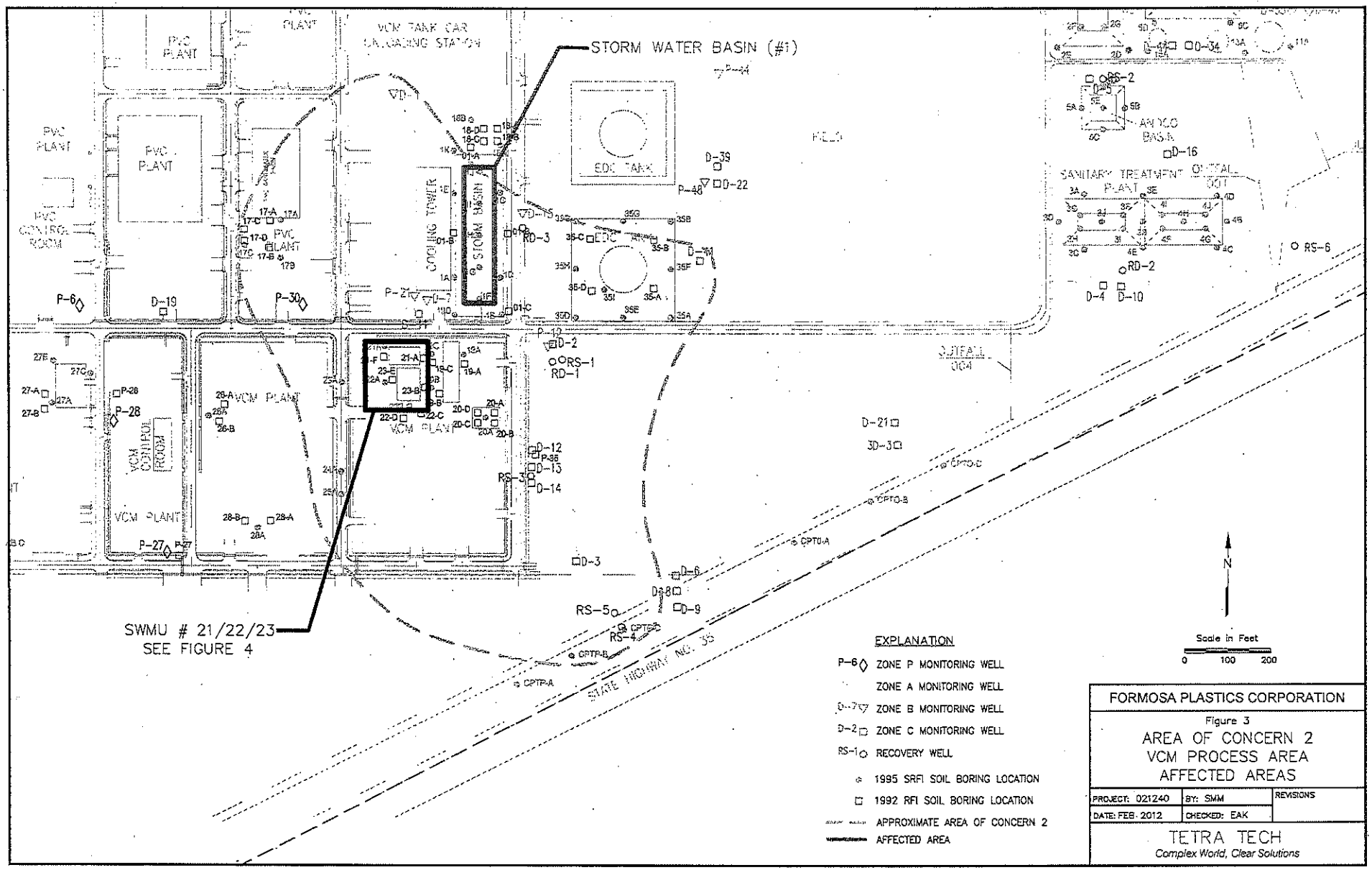
SITE VICINITY MAP

PROJECT: 021240	DATE: FEB 13, 2012
REV: 0	BY: SMM | CHECKED: EAK

TETRA TECH

complex world, clear solutions


EXPLANATION
ZONE P MONITORING WELL
ZONE A MONITORING WELL
ZONE B MONITORING WELL
ZONE C MONITORING WELL
RECOVERY WELL
1995 SRFI SOIL BORING LOCATION
1992 RFI SOIL BORING LOCATION
APPROXIMATE AREA OF CONCERN 1
AFFECTED AREA
EQUALIZATION BASIN
AERATION BASIN
WASTE WATER TREATMENT PLANT
SANITARY TREATMENT PLANT
OUTFALL 001
OUTFALL 005
OUTFALL 004
ANOCO BASIN
FIELD
EMERGENCY BASIN (#4)
SURGE BASIN (#3)
N
Scale in Feet
0
100
200
FORMOSA PLASTICS CORPORATION
Figure 2
AREA OF CONCERN 1
FORMER WWTP AREA
AFFECTED AREAS
PROJECT: 021240
BY: SMM
REVISIONS
DATE: FEB 2012
CHECKED: EAK
TETRA TECH
Complex World, Clear Solutions



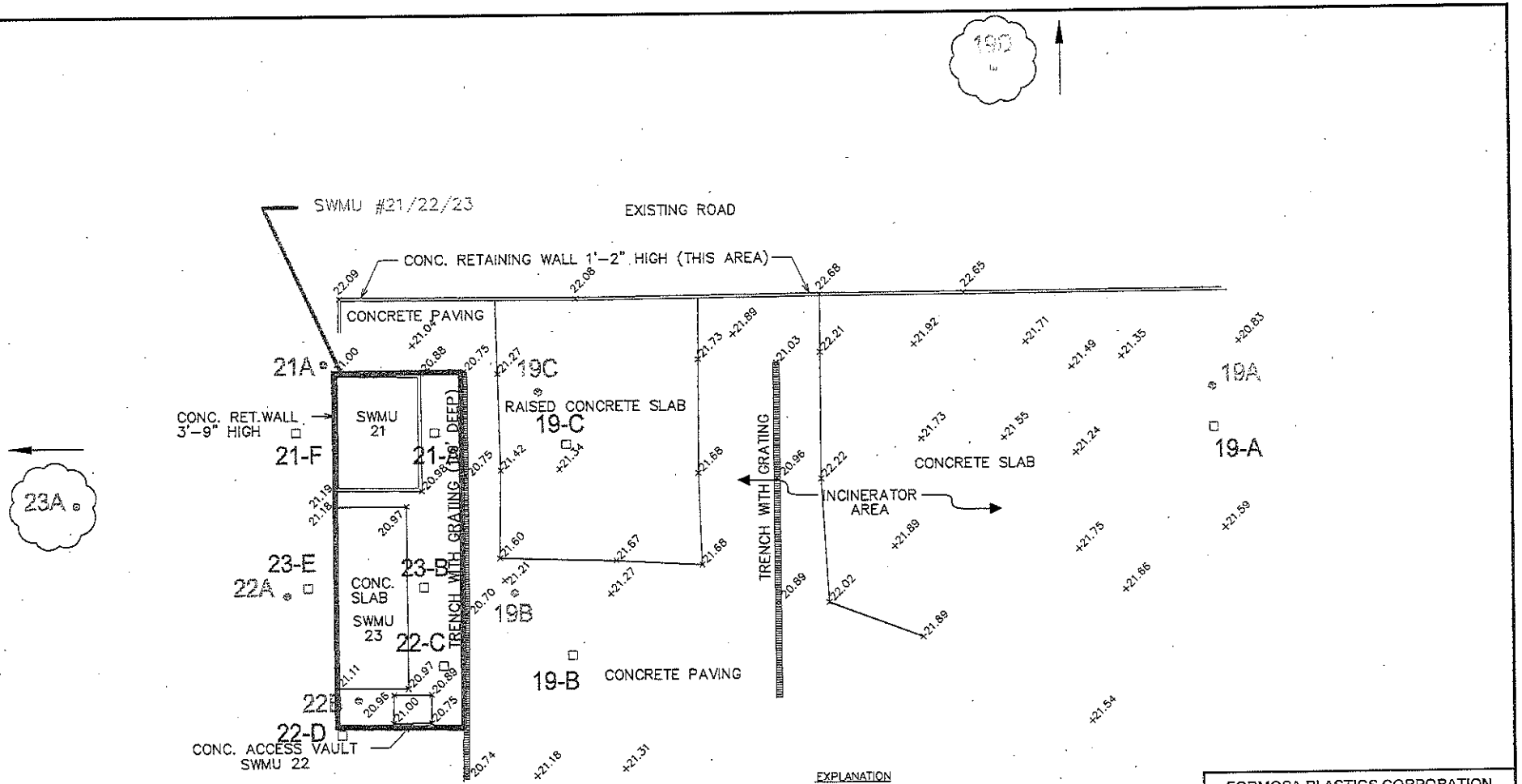
FORMOSA PLASTICS CORPORATION

Figure 3

AREA OF CONCERN 2
VCM PROCESS AREA
AFFECTED AREAS

PROJECT: 021240	BY: SMM	REVISIONS
DATE: FEB. 2012	CHECKED: EAK	

TETRA TECH
Complex World, Clear Solutions



SOURCE: Elevations and base map from Ganem & Kelly Surveying, Inc. dated Feb. 1, 2008.

FORMOSA PLASTICS CORPORATION

Figure 4

SWMU #21/22/23
AFFECTED AREAS

PROJECT: 021240	BY: SMM	REVISIONS
DATE: FEB 2012	CHECKED: EAK	

TETRA TECH
Complex World. Clear Solutions